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BACTERIAL EVALUATION OF THE BIOPOLYMER SELECTIVE PLUGGING FIELD TEST AT STANDARD HILL, SASKATCHEWAN

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EXECUTIVE SUMMARY

A field test of the NHRC biopolymer selective plugging system was carried out by Husky Oil Ltd. in the Standard Hill field, Saskatchewan under the "Extraction and Recovery of Bitumen and Heavy Oil Subprogram" operated by CANMET, EMR (Contract No. 23440-7-9066/01 SQ). This field has a history of wells watering out in a sequential southwest pattern, indicating an encroaching aquifer. Radioactive tracers identified the entrance point of this aquifer and the plugging system was injected at this point to inhibit the water influx.

A patented sacrificial agent was injected prior to the bacteria. This agent is primarily E1 stage pulp mill effluent obtained from the Weldwood mill in Hinton. This agent will increase bacterial dissemination because it precoats clays to which the bacteria otherwise stick. Injected bacteria were found 1.8 kilometres from the injection point confirming rapid dissemination did indeed occur.

A large inoculum of bacteria (~20,000 liters) was grown at Alberta Distillers Limited with no contamination. This was transported to the well site and was injected in a viable state.

Following an injection of ~190,000 liters of sugar beet molasses medium, the field was shut in to allow for polymer formation. After two weeks, eleven wells were put on production for a reservoir drawdown test to determine the extent of plugging achieved. Water samples were taken from these wells to determine the extent of bacterial travel and fermentation underground.

Results from the water samples indicated microbial growth, characteristic of the injected bacteria, had taken place. Positive identification of the injected bacteria was made at six of the eleven wells put on production. Molasses and metabolites from a molasses fermentation, characteristic of the injected bacteria, were seen in the produced water. The presence of polymer forming bacteria increased 1000 fold in produced water.

These observations confirm successful *in situ* application of the NHRC bug plug. The location of observed organisms and metabolites was deep in the reservoir far from the injection point. Despite precautions (reducing pump rates during injection), the bacterial system was flushed through the channel system deep into the reservoir prior to forming a stable plug. Presumably this was a result of high residual flow rates in the system.

The rapid dispersion of bacteria and molasses indicates the properties of this "channel system" were not well understood. This suggests, before any plugging system can be injected, a better understanding of the reservoir parameters and a good definition of plugging system target areas needs to be accomplished. Placement of any plug in high flow channels is a significant challenge which will require a substantially revised strategy.

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1.0 OBJECTIVE

To evaluate the use of *Leuconostoc mesenteroides* B523 as a plugging agent in high velocity low volume water "channels" in the Husky Standard Hill Field.

2.0 INTRODUCTION

NOVA HUSKY RESEARCH CORPORATION (NHRC) has developed and patented a novel microbial selective plugging system for profile correction in heavy oilfields (1). This system is the basis for a joint field project between Husky Oil Ltd. and CANMET, EMR under their "Extraction and Recovery of Bitumen and Heavy Oil Subprogram" entitled "FIELD TEST OF A NOVEL MICROBIAL SYSTEM TO IMPROVE RESERVOIR CONFORMANCE IN A WATERING OUT HEAVY OILFIELD", Contract No. 23440-7-9066/01 SQ.

The field project was divided into eight tasks: (i) evaluation of sacrificial agents in bacterial transport in laboratory cores, (ii) development of sacrificial agents for field use, (iii) evaluation of interwell radioactive tracers, (iv) collection of baseline data, (v) field preparation of sacrificial agent, (vi) preparation of bacterial inoculum, (vii) field injection, (viii) production analysis. Three reports have previously been submitted (2,3,4) covering use of sacrificial agents for enhanced bacterial transport, field preparation of sacrificial agents, and tracer analysis. This report covers the injection of sacrificial agent in the field, preparation of bacterial inoculum, injection of bacterial inoculum and polymer medium, and post-injection microbial analyses.

3.0 METHODS

3.1 Materials

3.1.1 Bacteria

The bacterial strain is *Leuconostoc mesenteroides* NRRL B523 obtained from the Northern Regional Research Laboratory, U.S. Department of Agriculture, Peoria, Illinois.

3.1.2 Inoculum Medium

The inoculum medium consists of 2 grams of glucose, yeast extract, tryptic soy broth, and dipotassium phosphate per liter of deionized water. Actual injection medium concentrations were 44.8 kg glucose, 47.7 kg yeast extract, 46 kg tryptic soy broth, and 40.5 kg dipotassium phosphate in approximately 22000 liters of deionized water. Initial pH of the medium was dropped to approximately 6.8 with the addition of 12 N HCl. All materials were obtained from Sigma Chemical Company, St. Louis, Missouri.

3.1.3 Polymer Medium

The polymer-producing medium is sugar beet molasses and sucrose from Alberta Sugar Company, Lethbridge. The medium consists of 120 g molasses, 60 g sucrose, and 4.5 g anhydrous piperazine (Texaco Chemicals, Ontario) per liter of water giving a final sucrose concentration of 12%. This medium was supplemented with 1.5% Difco agar and poured onto plates for the isolation of polymer forming bacteria. The injected field test polymer medium was formed by mixing 44000 kg molasses/sucrose blend (57.3% sucrose) with 191500 liters of piperazine buffered water to give a down hole sucrose concentration of 13%.

3.1.4 Sacrificial Agent

Sacrificial agent was obtained from the Weldwood pulp plant in Hinton, Alberta. E1 stage effluent (20000 liters) was brought to pH 7 with concentrated HCl by mixing the tank through a pump at a rate of 760 liters/min. The effluent was then treated in a proprietary fashion according to the patent held by Canadian Patents and Development Ltd. (CPDL), Ottawa, Ontario (5).

3.2 Procedure

3.2.1 Baseline Production Data

Baseline analysis for the field was determined by sampling the following wells: A1-2, A2-2, A3-2, A5-2 (satellite injection well), A6-2, A7-2, B8-2, A10-2, A15-2 (see map of area, Figure 23). Water chemistry was determined from samples taken August 19-21, 1987 and bacterial analysis from samples taken August 19,24 and 26, 1987.

3.2.1.1 Water Chemistry

Inorganic water chemistry was determined at the Husky Analytical Services Laboratory, Lloydminster. The parameters tested were pH, conductivity, surface tension, cations (Na, Ca, Mg, Fe, K), and anions (Cl, HCO_3, SO_4, CO_3, OH, NO_3, PO_4).

3.2.1.2 Bacterial Analysis

Analysis of the water for the presence of bacteria was determined by two methods - directly using plate counts for viable bacteria, and indirectly using gas chromatography to determine bacterial metabolites (alcohols, volatile fatty acids, non-volatile fatty acids).

General bacterial counts were made on half-strength Brain Heart Infusion agar (Difco). Analysis for polymer producers was done by looking for the production of mucoid colonies on molasses agar plates (sec. 3.1.3). Sulfate-reducing bacteria were analyzed using the most probable number technique with Postgate B medium supplemented with 1% NaCl (6).

Gas chromatography of the produced water for bacterial metabolites was done using standard procedures (7) and a Hewlett-Packard 5880A gas chromatograph equipped with a flame ionization detector and Level Four integrator. Columns used in the analysis were a glass 0.1% SP-1000 on 80/100 mesh Carbopack C for alcohols and a glass 10% SP-1000/1% H_3PO_4 on 100/120 mesh Chromosorb W AW for non-volatile and volatile fatty acids.

3.2.2 Sacrificial Agent Injection

The injection of 20000 liters of sacrificial agent into the reservoir was at a rate of approximately 40 liters/min with a Moyno 2L4 pump. This was done to accommodate a filtering unit with a 60 psi differential pressure limit. Pumping proceeded from the top of the source tank to avoid picking up pulp fibers which had settled out on standing. The filters used were three Polypure 30μ filters, three cellulose depth prefilters (nominal rating -3μ), three Polypure 3μ filters, and three Polypro 0.6μ filters. All filters were 75 cm cartridges which fit into standard three housing filter pots.

3.2.3 Field Inoculum

Leuconostoc mesenteroides B523 was grown at Alberta Distillers Limited to a field inoculum size of approximately 22000 liters from stock solution provided by NOVA HUSKY RESEARCH CORPORATION. The culture was scaled up from 5 - 10 mls to approximately 22000 liters at a concentration of 1 x 10^8 cells/ml. Scale up steps, bacterial concentration determination, and quality control procedures are outlined in Appendix A.

3.2.4 Field Injection

Injection protocol was:

(1) Preparation of piperazine buffered water;
(2) Injection of sacrificial agent;
(3) Injection of fresh water;
(4) Bleach flush of all surface lines;
(5) Ultra violet sterilized fresh water flush of bleach from surface lines;
(6) Inoculum injection;
(7) Inoculum push with four slugs of buffered water;
(8) Injection of molasses medium;
(9) Loading wellbore with bleach.

A detailed injection report is included in Appendix B.

3.2.5 Post-Injection Analyses

Analyses were carried out on samples from offset wells (Figure 23 - A1-3, A3-35, A4-35, A5-35, A6-35, A10-35, A11-35, A12-35, A9-34, A10-34, A16-34, A5-2 SATELLITE) in the same manner as the baseline. Microbial growth was monitored by dilution plating on molasses plates and counting polymer and non-polymer forming colonies. Gas chromatography for bacterial metabolites was done on a variety of samples obtained throughout the sampling period (August 15 - September 28). Physical chemistry of the produced water samples was determined at the Husky Analytical Services Laboratory, Lloydminster measuring the same parameters as in the baseline.

4.0 RESULTS

4.1 Sacrificial Agent

Sacrificial agent was prepared and injected into the well with little difficulty. The filtration of the sacrificial agent deviated from the plan outlined in a previous report (3). The Polypro 0.6μ filters plugged within 30 - 40 minutes at a flow rate of 40 liters/minute. This rate depleted the filter supply within several hours and a decision was made to proceed without 0.6μ filtration. The injection continued with careful monitoring of the wellhead pressure to determine if facial plugging was taking place. No increase in pressure was seen.

Monitoring the rate and extent of sacrificial agent travel in the reservoir was not possible, making it difficult to determine the capability of the sacrificial agent to enhance the travel of bacteria.

4.2 Inoculum Preparation

At the initiation of this project, NOVA HUSKY RESEARCH CORPORATION did not have experience in growing *Leuconostoc mesenteroides* B523 at the scale required. A search for expertise and facilities was made throughout the province by contacting the Alberta Research Council (ARC) Biotechnology Pilot Plant, local breweries, and distillers. After preliminary studies at ARC, inoculum preparation was carried out successfully by Alberta Distillers Limited (ADL).

4.2.1 ARC Biotechnology Pilot Plant

Arrangements were initially made at the Biotechnology Pilot Plant for preparation of the inoculum. In preparation for scale up, and to determine attainable cell densities, two 16 liter fermentations were done at ARC. The results of these fermentations are shown in Figures 1 and 2.

Figure 1 is a fermentation done without introduction of air. *Leuconostoc* belongs to the lactic acid bacteria group and is an aerotolerant anaerobe. According to Brock *et al* (8), many strains of lactic acid heterofermenters can use O_2 as an electron acceptor with a flavoprotein serving as electron donor. This causes the conversion of acetylphosphate to acetate instead of ethanol, and synthesis of an additional ATP.

The depletion of O_2 in Figure 1 and the evolution of acetic acid in other growth studies (Appendix D) gives evidence *Leuconostoc* has this ability. CO_2 evolution was not possible to measure in this fermentation because there was no gas flow carrying the produced gases to the gas chromatograph. Generation time was 84 minutes (Figure 3) and acid production overcame the phosphate buffer after 10 generations. After 24 hours the viable cell density was 7×10^8 cells/ml.

Figure 2 is an aerobic fermentation done to determine the effect of air on bacterial growth. Figure 3 indicates a generation time of 102 minutes, a small amount of CO_2 production during early log to stationary growth phases, and neutralization of the phosphate buffer after approximately 10 generations. After 24 hours of fermentation the viable count was 7×10^8 cells/ml.

Anaerobic growth is preferred for two reasons: (i) less cost, and (ii) past experience has indicated cells grown under anaerobic conditions penetrate further into sand and clay (2). These runs illustrate there was no difference between a fermentation with or without air in *Leuconostoc* growth. Oxygen did not increase the growth rate as would be expected with the production of acetic acid and the generation of ATP.

4.2.2 Alberta Distillers Limited

After several delays and scheduling difficulties at ARC, NHRC was forced to find alternate inoculum preparation facilities three weeks before the last possible field test injection date permissible by the project deadline. Two companies were found that were willing and capable of growing the inoculum; Drummond Breweries in Red Deer, Alberta, and Alberta Distillers Limited in Calgary. ADL was chosen because of their capability to sterilize 13000 liters at one time and their expertise in growing lactic acid bacteria.

The results of the fermentation done at ADL are found in Appendix A. Additional plating was done at the Standard Hill site to determine viability and purity of the culture after being transported in a disinfected tanker truck. No contamination was evident and the viable plate count was 4×10^7 cells/ml. The pH of the inoculum was 4.5. Samples were also inoculated into laboratory prepared molasses medium, and the molasses medium for injection into the well. The polymer quality and yield in the injection molasses medium was satisfactory and similar to the lab medium.

4.3 Post-Injection Microbial Analyses

4.3.1 Water Chemistry

Physical changes in the produced water samples are illustrated in Figures 4 - 12 and Appendix C. Figures 4,6, and 8 are illustrations of the baseline trends seen in Section 2 of 50-22-W3M where the injection took place (Figure 23). Figures 5,7, and 9 are the trends taking place in the off set sections produced after injection. The wells used for data in Figures 5,7, and 9 were eight wells which appeared to have the most change post-injection; i.e. most likely in or immediately adjacent to the proposed channel.

Figures 4 and 5 illustrate any changes in the overall reservoir pH. On August 15 in Figure 5 there is a wide variation in pH from well to well. In well A1-3 the pH is approximately 9 which is indicative of residual sacrificial agent. Sacrificial agent has a tendency to become more basic with increased time from neutralization. Well A6-35 has a pH of 5.5 which indicates acid producing bacterial growth. The injected organism, *Leuconostoc* mesenteroides, is expected to reduce pH values where growth occurs. Aside from these variations on August 15, the pH values in Figures 4 and 5 are very similar.

Figures 6 and 7 show the changes in conductivity that took place. Figure 6 indicates the normal conductivity of the aquifer brine moving through the "channel" system is between 42 and 45 mS/cm, based on 24 samples. The freshening trend at wells A1-3, A3-35, A4-35, A5-35, A6-35, A12-35, A9-34, and A16-34 (Figure 23) in Figure 7 appears to be somewhat cyclical indicating an intermittent supply of fresh water. The lowest conductivities were seen in two periods, Aug. 18 - 19 and Aug. 26 - 27.

At the A5-2 satellite, the collection point for all the water produced in the area, conductivity readings on August 19 and 27 indicated produced waters had been diluted by 80% and 87.5% respectively, with molasses medium (13.09 mS/cm). Assuming freshening remained constant throughout the sampling period, this amount of freshening indicates 98% of the fresh water injected was pumped back on those two days. Figure 24 marks all the wells that were tested and the number of days conductivity fell below 30 mS/cm. This conductivity represents a 60% dilution using 53.1 mS/cm as an average conductivity for the post injection production water.

The high conductivities noted initially (Figure 7) for certain wells may reflect the salinity of the in place or connate brine in the formation. These wells had been shut in for long periods prior to production for this test.

Figures 8 and 9 compare the surface tension of the produced waters. The surface tension was lower after injection (Figure 9) indicating bacterial growth at all the wells in but not extensive surfactant production. Surfactant producing lab cultures will often have surface tensions in the range of 2 dynes/cm.

The cation/anion analyses (Figures 10-12, Appendix C) indicate there was a change from the baseline to post-injection. Normally, in produced water samples the cations and anions will balance, but after injection this was not the case, indicating the presence of some organic salt which was not being resolved during ion chromatography. The high levels of cations seen in Figure 11 on the first day of production (August 15) most likely indicated connate brine.

4.3.2 Bacterial Metabolite Analyses

The results of gas chromatography analyses for alcohols and fatty acids (volatile and non-volatile) are summarized in Figures 13 and 14 and Appendix D. The total alcohol concentrations found in the samples ranged from non-detectable to 460 mg/L (Figure 13). Ethanol, isopropanol, propanol, and butanol production were used as indicators of bacterial growth because they were not present in the baseline samples (Appendix D). *Leuconostoc mesenteroides* B523 produces ethanol as a metabolite (Appendix D).

Figure 13 illustrates that ethanol was found at high levels on the first day of production following the injection and incubation period but quickly dropped with subsequent production. Well A6-35 accounted for 100% of the ethanol produced on August 15 but its production quickly fell to approximately 20 mg/L at this location. No other well was dominant in ethanol production except A12-35 which accounted for 30-50% of the ethanol produced on the following days. Volatile fatty acid production is illustrated in Figure 14. In the baseline results (Appendix D) acetic acid, propionic, and butyric were not measurable. After molasses injection, every well was producing some acetic acid. The highest levels were seen on August 15 with A6-35 producing approximately 95% of the acetic acid. Levels dropped at this well by the next day to the amounts seen in the rest of the field (~65 mg/L). *Leuconostoc* will produce acetic acid from glucose fermentation but not as a major fermentation product (8). The results obtained at NHRC indicate that our strain of *Leuconostoc mesenteroides*, B523 produced 2600 mg/L acetic acid, 1430 mg/L ethanol and 9500 mg/L lactic acid when inoculated into an aerobic medium and incubated anaerobically for one week (Appendix D). Other volatile acids appearing with post-injection production were propionic and butyric. *Leuconostoc* do not produce these acids which makes them good indicators of growth by other organisms in the reservoir. A12-35 was the major producer of propionic and butyric acids suggesting the high levels of ethanol produced from this well were not from *Leuconostoc* but from the indigenous population.

Non-volatile fatty acids have been used in the past (9) for indication of lactic acid bacteria. In the current test, lactic acid appeared only on the first day of production in one well, A6-35, (Figure 25) complimenting the ethanol and acetic acid observations made above. The level at this point was high (4000 mg/L) but was reduced to non-measurable amounts by the next sampling period. This pattern was again consistent with the pattern of ethanol and acetic acid. Figure 15 compares the levels of fermentation products generated by *Leuconostoc* in laboratory molasses medium with those recovered from well A6-35 on August 15, fourteen days after injection. Over 50% of the lactic and acetic acid levels produced by *Leuconostoc* in a lab fermentation were found in A6-35 the first day of production. Close to 30% of ethanol normally produced was also found. The pH and conductivity of this well were 5.49 and 34.9 mS/cm respectively, showing acid production and some freshening had taken place. All observations are consistent with the *in situ* growth and metabolism of the injected culture at this location (A6-35).

Evidence of molasses was also seen on August 15 (Figure 15, 11% of the fructose normally found after lab fermentation), indicating the molasses medium had travelled approximately 1.8 kilometers from the injection site (Figure 25). The sugar component of molasses is sucrose, a disaccharide made up of glucose and fructose. *Leuconostoc* metabolizes sucrose by hydrolyzing the bond joining the two sugars using an enzyme, dextransucrase. Glucose is utilized preferentially by *Leuconostoc mesenteroides* B523 for energy production and dextran polymer formation, leaving fructose in the fermentation broth. These lab results support the results from A6-35.

4.3.3 Bacterial Growth

Figures 16 - 22 and Tables 1 and 2 illustrate the change in bacterial population taking place in the sampling area during this test. Figure 16 indicates the low level of the indigenous microbial population ($<10^3$/ml) occurring in the reservoir before injection. Polymer formers were found only once in one well (A2-2) at very low levels (i.e., 60 colony forming units(CFU)/ml).

The CFU's on the first day of production after injection were generally lower than the baseline which was not expected, but increased to baseline levels by the second day of production (Figures 17, 19, 21, and 22). Polymer forming CFU's increased dramatically as illustrated in Figures 17, 18, and 20. There were a variety of cellular types amongst the polymer formers, but all were gram positive organisms, as was the injected culture.

Those organisms which resembled *Leuconostoc* were sent for identification by their fatty acid methyl ester profiles at Microbial ID, Inc., Newark, Delaware, U.S.A. Matching of profiles with the injected culture allowed identification of the injected organisms in the produced water of wells A15-2, A1-3, A3-35, A5-35, A11-35, A10-34, and A16-34 (Figure 25). Their report is included as Appendix E.

5.0 DISCUSSION

5.1 Inoculum Preparation

The preparation of large quantities (20,000 L) of bacterial inoculum for injection into oil wells is a feasible task in Alberta. There is expertise and adequate, available facilities for sterile media preparation and uncontaminated bacterial growth.

Transportation of the inoculum aseptically is a potential problem. However, in this test the finished fermentation was at a low enough pH (4.5) to inhibit many contaminants and contamination was not detected by plate counts done at the injection site as the inoculum left the tanker truck. The activity of the injection inoculum could be a problem on very long trips. The viable plate counts taken as the inoculum entered the well were reduced by 50% from the plate counts taken at ADL as the inoculum was loaded on the truck. The time interval between the plate counts was approximately 24 hours. If the inoculum concentration was increased to greater than 2×10^8 viable cells/ml, the percentage drop in viability would not be critical. The ideal, viable inoculum concentration should be no less than 10^8 cells/ml for optimum penetration into the reservoir (2).

Media composition is an area for improvement in this process. The cost of ingredients for growth of the inoculum was over $3000. For routine oil field service, costs must be reduced and a survey of existing by-products should be done to determine if there is a suitable lower cost substrate available to provide a vigorous but inexpensive inoculum.

5.2 Injection

5.2.1 Sacrificial Agent

Sacrificial agent was used in this test to decrease the adsorption of bacteria to the reservoir material. In the sacrificial agent used, there is a quantity of fibrous particles capable of plugging 1 Darcy unconsolidated sand packs (3). Filtration will remove these particles to allow penetration of the sacrificial agent (3). A filtration scheme was developed to remove particulates $>0.6\mu$ diameter for the field test but proved inadequate and failed rapidly. Consequently, filtration was continued at a larger retention size (3μ) and no increase in injection pressure was seen. This indicates the reservoir face is not as tightly packed as the lab sand pack and, for Lloydminster unconsolidated sand reservoirs, expensive submicron filtering may not be necessary at all.

5.2.2 Bacterial and Molasses Travel through the Formation

The injection of bacteria was followed by four 5 m^3 pulses of water to enhance bacterial travel into the reservoir and along the channel. Two wells were pumping throughout this process, A15-2 and A3-2. These wells were left pumping to direct the flow of bacteria and molasses along the channels defined during the tracer study (4). At the end of molasses injection, the samples taken from these wells had sucrose concentrations greater than 1% and polymer forming bacterial numbers had increased by at least fifty fold. The results of identification by fatty acid methyl esters gives the isolate examined from A15-2 a similarity index of 0.934 in comparison with the injection bacteria. Indices above 0.9 are within the standard deviation of the four cultures making up the reference library. On this basis, isolates from wells A15-2, A1-3, A3-35, A5-35, A11-35, A10-34, and A16-34 were identical to the injected bacteria (Figure 25).

Injection ended on August 1 and the system was allowed to incubate for two weeks. Production was initiated on August 15. The results illustrated in Figure 15 show the concentration of molasses medium was great enough in well A6-35 to produce high levels of metabolites characteristic of *Leuconostoc mesenteroides* with excess sugar remaining. The polymer forming colonies from this well during the initial production period produced a bacterial lawn on molasses agar plates at a dilution of 10^{-5} representing a population in excess of 10^6/ml. Polymer forming colonies were not seen at these levels in any other wells. The increased concentration could represent several possibilities: (i) the front of a molasses/bacterial flood, (ii) stimulation of the *in situ* polymer forming bacteria by a pool of molasses medium, or (iii) the multiplication of injection bacteria remaining from the passing of the molasses/bacterial flood. The results of microbial identification show that injected *Leuconostoc* reached this well (Figure 25). The distance travelled in this example would be approximately 1.8 kilometers, or greater than 100 meters per day, assuming straight line travel between B8-2 and A6-35 (Figure 23). While injected *Leuconostoc* also reached the wells listed above, analysis of the fermentation products failed to indicate the high level of *in situ* growth and metabolism observed at A6-35.

Comparison of Figures 24 and 25 implies the travel and dispersion of injected *Leuconostoc* and molasses was very similar. The patterns for positive identification of *Leuconostoc* and greatest decrease in conductivity can be superimposed on each other. Using these patterns as indicators of the "channel" system, the flow appears to be greatest down the border between Sections 34 and 35 and in a southwest diagonal across Section 34 into Section 28.

5.3 Bacterial Growth *In Situ*

The presence of slime forming bacteria in the produced water after injection and their absence during baseline studies suggest polymer formation took place in the reservoir. Additionally, excess fructose in A6-35 indicates a *Leuconostoc*-like pattern for metabolism and polymer production. Comparison of Tables 1 and 2 show the only significant change in bacterial growth occurred with polymer formers. Figures 13 and 14 illustrate the general increase in bacterial metabolites seen throughout the production area. After approximately two weeks, the levels began to decrease indicating the bloom of activity caused by the injected molasses was subsiding. The bacterial numbers in Table 2 also support the fatty acid evidence. The pattern seen in Figure 14 provides some insight into the characteristics of the general reservoir population. Initially, lactic acid, acetic acid, and ethanol were the primary metabolites seen in the reservoir (Figure 15). When produced waters were inoculated into molasses medium during baseline determinations (Appendix D) this was also the response, indicating the possibility of indigenous heterofermentative lactic acid bacteria in the reservoir. These metabolites diminished during the following days of production with a corresponding increase in acetic, propionic, and butyric acids. Maximum levels of these metabolites were evident on August 24 (Figure 14). The rise in these acids indicated secondary metabolism of lactic acid which is the primary substrate for propionic bacteria. The presence of butyric acid, butanol, acetic acid, acetone, and isopropanol gave evidence other biochemical pathways evolved with the injection of carbohydrates into the well. These metabolites are commonly produced by *Clostridia* (8) and other common soil bacteria.

5.4 Water Chemistry

Examination of the physical parameters of the produced water indicates a change took place in the reservoir after injection of the plugging system. The pH changes seen were not large, except for isolated wells, which suggest pockets of microbial activity. Examples of this would be wells A6-35 and A12-35. This isolated pattern indicates bacteria are not travelling or being retained at the same rates throughout the highly permeable "channel" system.

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Surface tension measurements of the produced water have a high degree of scatter, probably because of the measuring technique, a hand cranked tensiometer. There is a decrease in surface tension towards the end of the sampling period which corresponds to an increase in propionic and butyric acid levels. These acids are produced by microorganisms which are known to secrete organic molecules with surfactant-like properties (10).

The conductivity measurements indicate freshening of the reservoir brine. The conductivity fluctuation in diverse wells suggests fresh water traveled in slugs through the reservoir. This cyclical pattern would not be expected for an even linear displacement of the injected fresh water slug through the "channel" system. Some of the conductivity readings show a five-fold dilution of the baseline brine. On August 27 the freshening of the connate brine produced a low conductivity brine front stretching from A1-3 to A11-35 with fingers at A10-34 and A3-35 (Figure 24). The degree of freshening from these wells was enough to dilute the conductivity in the satellite well by 87.5% (Appendix C). One explanation of the extent of freshening would be the influx of fresh water from other sources than the 240 m^3 injected during the test. A partial plug holding back some of the aquifer source brine and allowing a relative increase in the influx of fresh ground water could explain this phenomenon, but may not be consistent with other reservoir observations.

In the absence of an alternate source of fresh water, a low volume interconnected "channel" system with very little dilution or mixing from connate brine must be assumed.

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6.0 CONCLUSIONS

6.1 Inoculum

The inoculum and media preparation for the biopolymer plugging system was successful. Identification methods comparing the inoculum delivered to Alberta Distillers Limited, the inoculum as it left ADL, and the injection inoculum had very high similarity indices, indicating B523 remained stable and uncontaminated throughout the 20 m^3 scale up procedure at Alberta Distillers Limited. The injected bacteria were capable of producing polymer comparable to lab cultures.

6.2 Sacrificial Agent

Twenty cubic meters of sacrificial agent were prepared from Weldwood E1 stage pulp mill effluent (Hinton, Alberta) and injected into the well. The sacrificial agent was filtered to 3μ and no evidence of facial plugging in the well bore was seen. The sacrificial agent coupled with injection pulsing of the inoculum were to insure dissemination of the bacteria. Injected *Leuconostoc* were seen 1.8 kilometers from the point of injection.

6.3 Growth *In Situ*

Bacterial growth did occur underground in molasses medium. There is evidence, based on the production profiles for lactic acid, acetic acid and ethanol, that a heterofermentative lactic acid organism grew in the formation. *Leuconostoc* carries out this type of fermentation. Insoluble polymer formers resembling *Leuconostoc* were identified in the produced water samples. They produced polymer on sucrose but not on glucose. Over 60% of the polymer producing isolates examined by fatty acid analysis were identified as the injection bacteria. The results indicate *Leuconostoc mesenteroides* was dispersed extensively throughout the reservoir and carried out the expected pattern of growth and metabolism in areas of the reservoir, notably near well A6-35.

6.4 Plug Formation

The chemistry of the produced water implies insoluble polymer formation and therefore plugging took place. Rapid and wide spread transport of B523 suggests high velocities in the channel system. This appears to have flushed the bacterial system deep into the reservoir, without retention of sufficient bacteria and medium to allow significant plug formation to occur in the "channel" throat near the injection well. Sporadic plugging of "side channels" deep in the extensive system would not be expected to reduce water influx into the field.

7.0 RECOMMENDATIONS

1. The microbiological success of this test indicates a plugging tool has been developed. Failure to plug off the water influx suggests extensive work defining the target for plugging systems needs to be done.

2. The distance of bacterial and media dispersion indicates further work on the reservoir parameters needs to be accomplished before any plugging tool can be used successfully. It also suggests concerns about limited bacterial transport may be exaggerated in this kind of application

3. Additional development on a more durable "bug plug" would be of value for "channel" or formation plugging.

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9.0 TABLES

TABLE 1: STANDARD HILL PRODUCED WATER SAMPLES, BASELINE BACTERIAL COUNTS

	WELLS								
DATE	A1	A2	A3	A5	A6	A7	A10	A15	B8
87/08/19	$4.9\text{x}10^{3}$	$5.4\text{x}10^{4}$	$2.3\text{x}10^{5}$	<10	$6.9\text{x}10^{2}$	$8.9\text{x}10^{4}$	$8.6\text{x}10^{3}$	$8.0\text{x}10^{4}$	$3.2\text{x}10^{4}$
87/08/24	$3.5\text{x}10^{4}$	$1.6\text{x}10^{4}$	$1.7\text{x}10^{6}$	$7.3\text{x}10^{2}$	$3.1\text{x}10^{3}$	$3.9\text{x}10^{5}$	$1.1\text{x}10^{5}$	$3.4\text{x}10^{4}$	$4.6\text{x}10^{4}$
87/08/26	$1.1\text{x}10^{4}$	$3.0\text{x}10^{3}$	$5.1\text{x}10^{4}$	$2.1\text{x}10^{2}$	$1.3\text{x}10^{4}$	$1.0\text{x}10^{4}$	$2.3\text{x}10^{5}$	$5.4\text{x}10^{4}$	$2.7\text{x}10^{4}$

Counts represent total bacterial counts on molasses agar plates incubated anaerobically. Polymer formers were found in Well A2-2 on August 26, 1987 at a concentration of 60 cells/ml.

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TABLE 2: STANDARD HILL PRODUCED WATER SAMPLES, POST INJECTION BACTERIAL COUNTS

WELLS

DATE	A1-3 (T)	COUNT (P)	A3-35 (T)	COUNT (P)	A4-35 (T)	COUNT (P)	A5-35 (T)	COUNT (P)	A6-35 (T)	COUNT (P)	A10-35 (T)	COUNT (P)
88/08/15	<10		<10		<10		<10		Lawn			
88/08/16			1.8×10^4	7.0×10^3	6.2×10^4	4.0×10^3	1.9×10^5	1.9×10^4	Lawn		<10	
88/08/17	8.8×10^4	2.2×10^4	2.0×10^5	2.7×10^4	5.7×10^4	1.6×10^4	2.0×10^5	3.4×10^4	Lawn		Oil	
88/08/18	9.0×10^4	2.3×10^4	6.5×10^4	2.3×10^4	1.3×10^5	3.0×10^4	2.0×10^5	3.6×10^4	Lawn			
88/08/19	5.4×10^4	1.7×10^4	2.3×10^5	2.1×10^4	3.0×10^5	2.7×10^4	1.0×10^6	2.0×10^4	2.0×10^5	1.0×10^5	Oil	
88/08/20	1.0×10^5	1.9×10^4	3.0×10^5	1.7×10^4	6.0×10^5	2.5×10^4	3.0×10^6	2.2×10^4	1.8×10^5	1.2×10^4		
88/08/21	1.0×10^5	2.5×10^4	2.0×10^5	7.0×10^3	2.0×10^4	1.5×10^4	4.0×10^6	2.4×10^4	9.0×10^5	2.2×10^4	Oil	
88/08/23	1.5×10^5	3.3×10^4	2.0×10^5	1.7×10^4	3.3×10^4	8.0×10^3	8.0×10^5	8.0×10^3	4.0×10^6	2.6×10^4		
88/08/24	1.0×10^5	4.6×10^4	2.4×10^4	9.0×10^3	2.0×10^5	2.4×10^4	9.0×10^5	1.4×10^4	4.0×10^5	2.3×10^4		
88/08/25	1.8×10^5	8.0×10^4	2.5×10^5	1.7×10^4	4.0×10^5	7.0×10^3	3.0×10^5	6.0×10^3	7.0×10^6	1.8×10^4	8.0×10^4	7.0×10^3

DATE	A11-35 (T)	COUNT (P)	A12-35 (T)	COUNT (P)	A9-34 (T)	COUNT (P)	A10-34 (T)	COUNT (P)	A16-34 (T)	COUNT (P)	SATELLITE (T)	COUNT (P)
88/08/15	<10		<10		<10		3.5×10^3	1.0×10^3			<10	
88/08/16							2.0×10^5	4.3×10^4				
88/08/17					2.0×10^5	3.9×10^4	2.0×10^5	6.4×10^4				
88/08/18	1.6×10^5	2.1×10^4			1.4×10^5	4.4×10^5	1.8×10^5	3.6×10^4	2.0×10^5	2.4×10^4		
88/08/19	3.0×10^5	1.7×10^4	1.0×10^5	6.0×10^4	3.0×10^5	3.4×10^4	1.0×10^6	4.0×10^4	2.1×10^4	3.0×10^3	7.0×10^4	7.0×10^3
88/08/20	1.5×10^5	1.6×10^4	1.0×10^5	4.0×10^4	4.0×10^5	3.0×10^4	1.0×10^6	2.2×10^4	2.0×10^5	1.8×10^4	8.2×10^4	6.0×10^3
88/08/21	2.0×10^5	2.0×10^4	1.5×10^5	2.0×10^4	3.0×10^5	4.0×10^4	1.0×10^6	2.5×10^4	1.0×10^5	1.4×10^4	7.0×10^3	1.4×10^2
88/08/23	2.0×10^6	1.6×10^4	6.0×10^4	7.0×10^3	2.0×10^5	2.8×10^4	7.0×10^5	5.4×10^4	2.0×10^5	3.1×10^4	1.7×10^5	3.0×10^3
88/08/24	1.0×10^5	1.0×10^4	1.2×10^5	1.5×10^4	9.5×10^4	2.9×10^4	1.0×10^6	4.2×10^4	1.0×10^5	3.1×10^4	1.8×10^5	3.0×10^3
88/08/25	2.0×10^5	1.2×10^4	1.5×10^5	1.3×10^4	1.0×10^6	1.3×10^4	3.0×10^5	1.8×10^4	4.0×10^5	1.1×10^4	5.0×10^3	2.0×10^1

(T) Total bacterial counts on molasses agar plates incubated anaerobically.
(P) Polymer forming bacterial counts on molasses agar plates incubated anaerobically.

10.0 FIGURES

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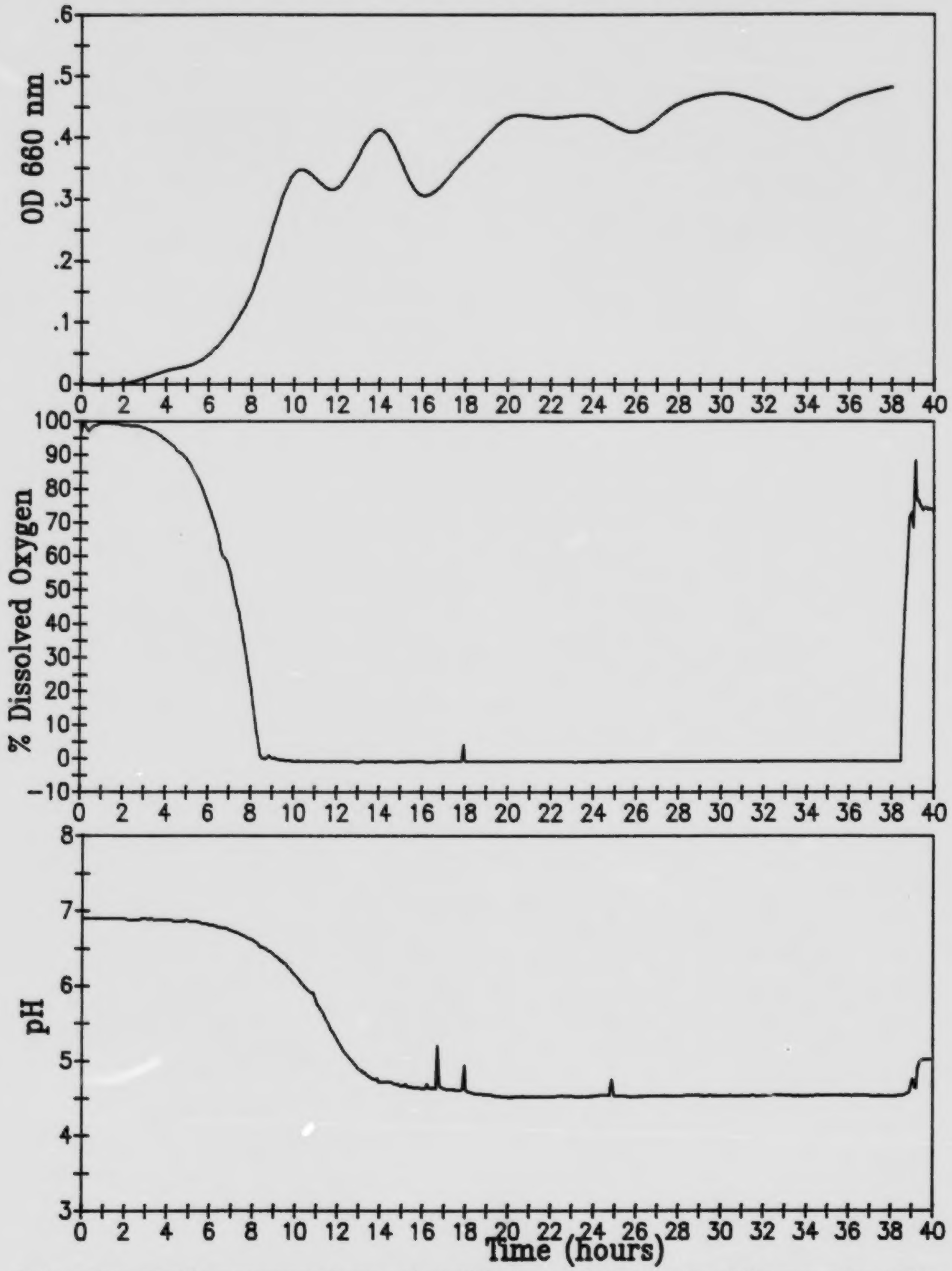
Figure 1. 16 l Anaerobic Fermentation
Leuconostoc Mesenteroides B523



Note: Carbon Dioxide measurement was not possible due to the mechanics of the measuring system
Other parameters which remained constant throughout the fermentation were:
Temperature 30 C
Agitation 500 RPM

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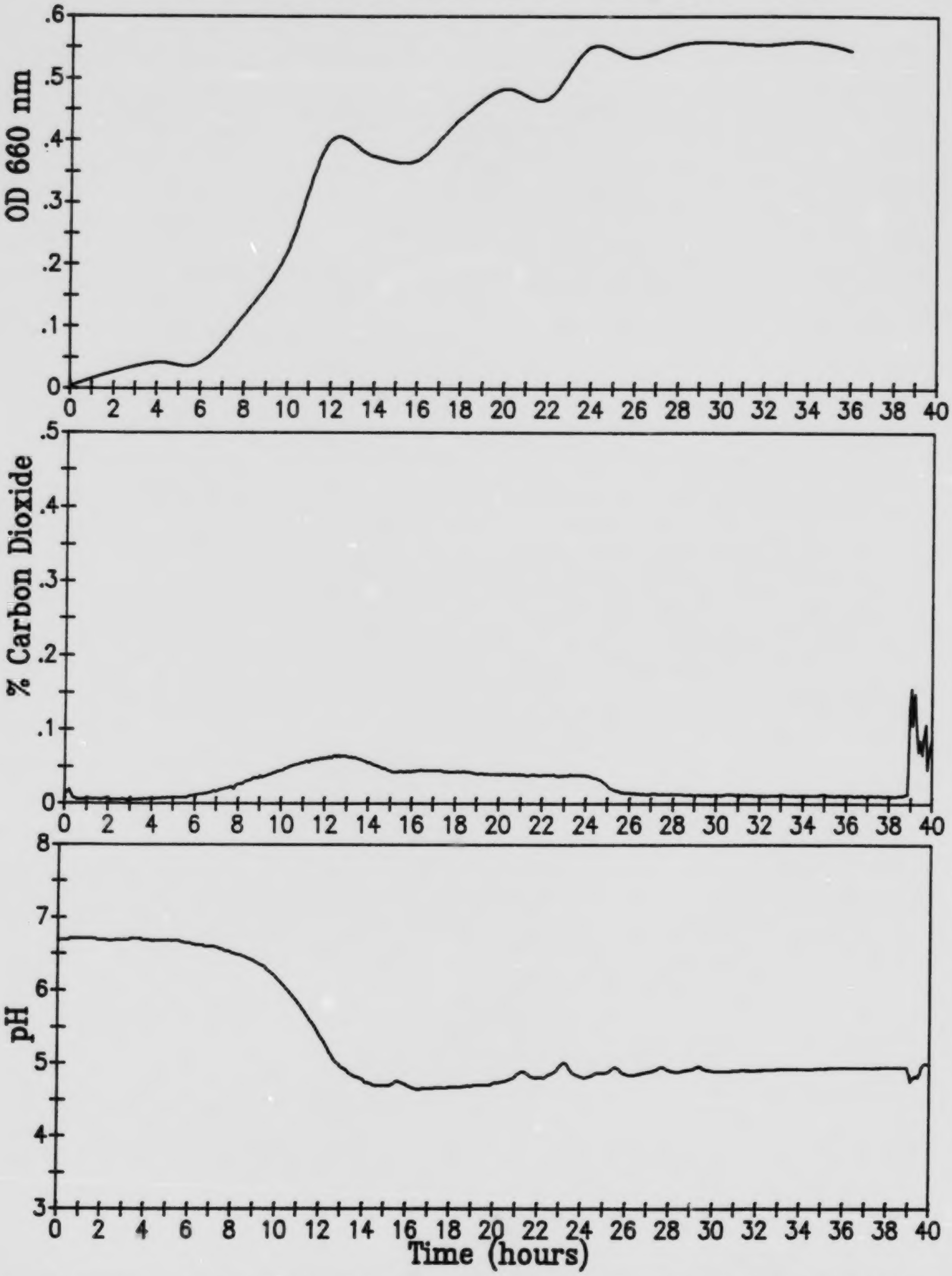
Figure 2. 16 l Aerobic Fermentation of *Leuconostoc Mesenteroides* B523



Note: Other measured parameters which remained constant throughout the fermentation were:
Temperature 30 C
Agitation 500 RPM
% Oxygen 21%

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FIGURE 3 LEUCONOSTOC GROWTH CURVE DURING FERMENTATION WITH AND WITHOUT AIR

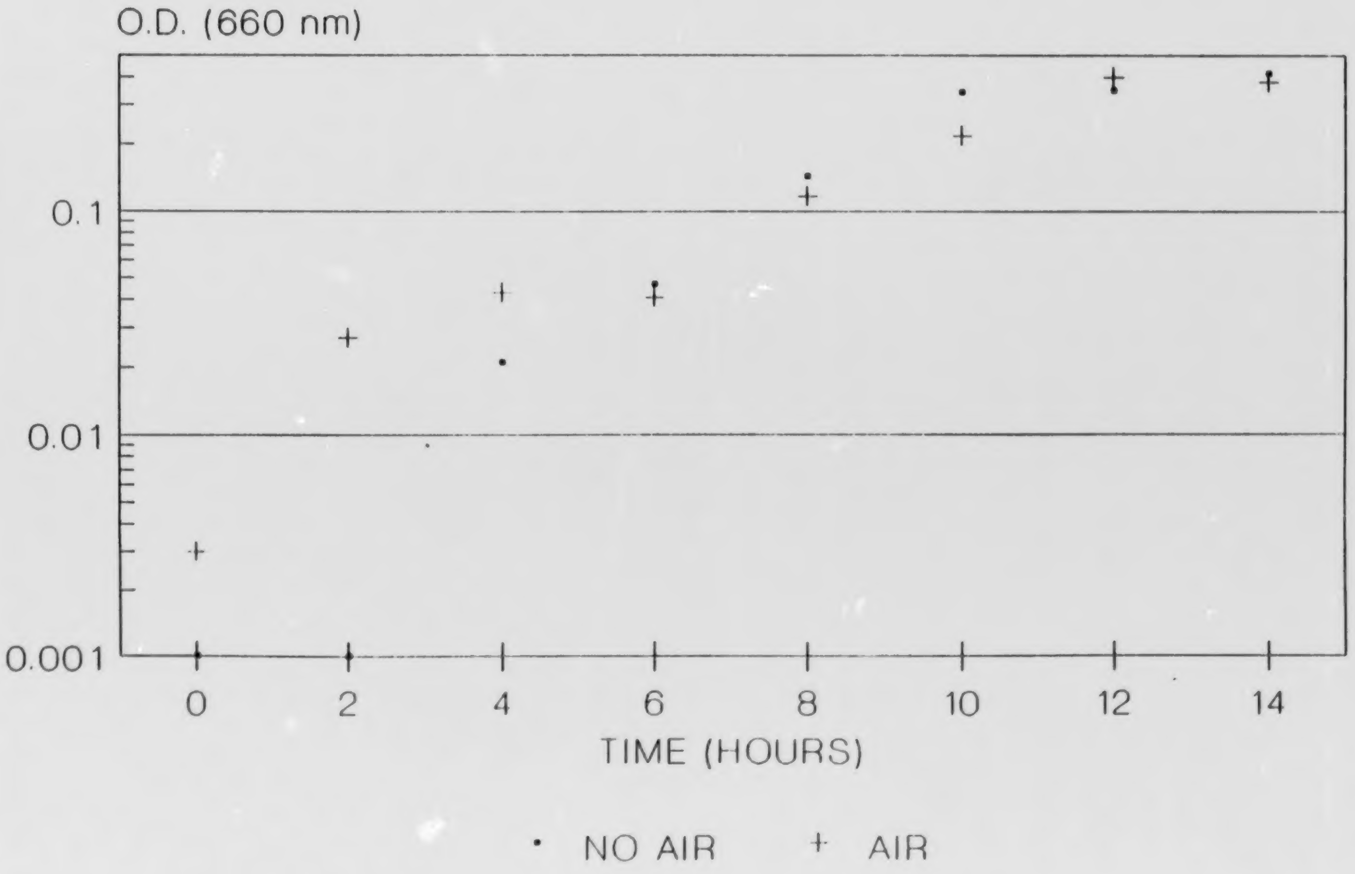

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FIGURE 4 STANDARD HILL PRODUCED WATER SAMPLES - BASELINE pH

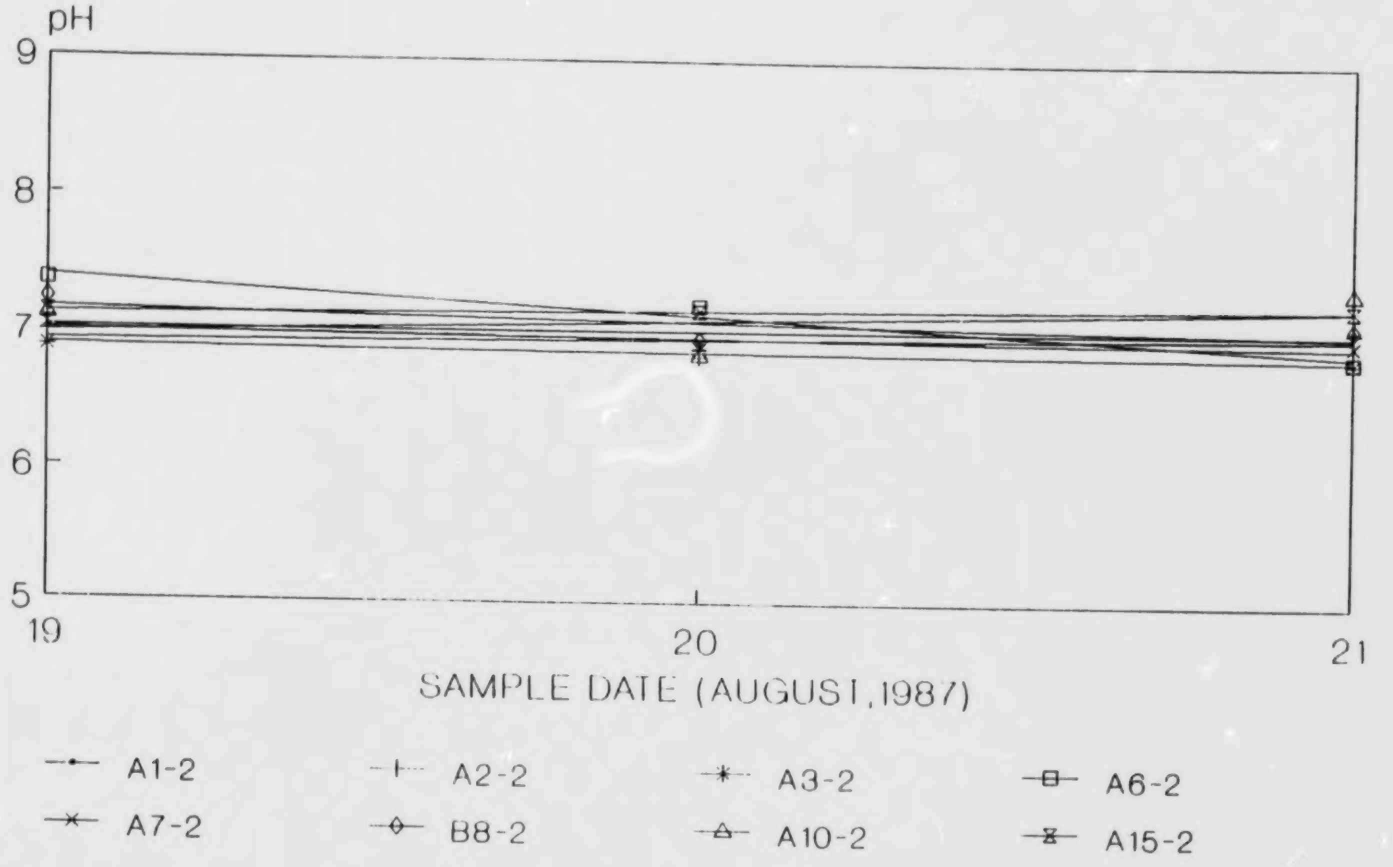

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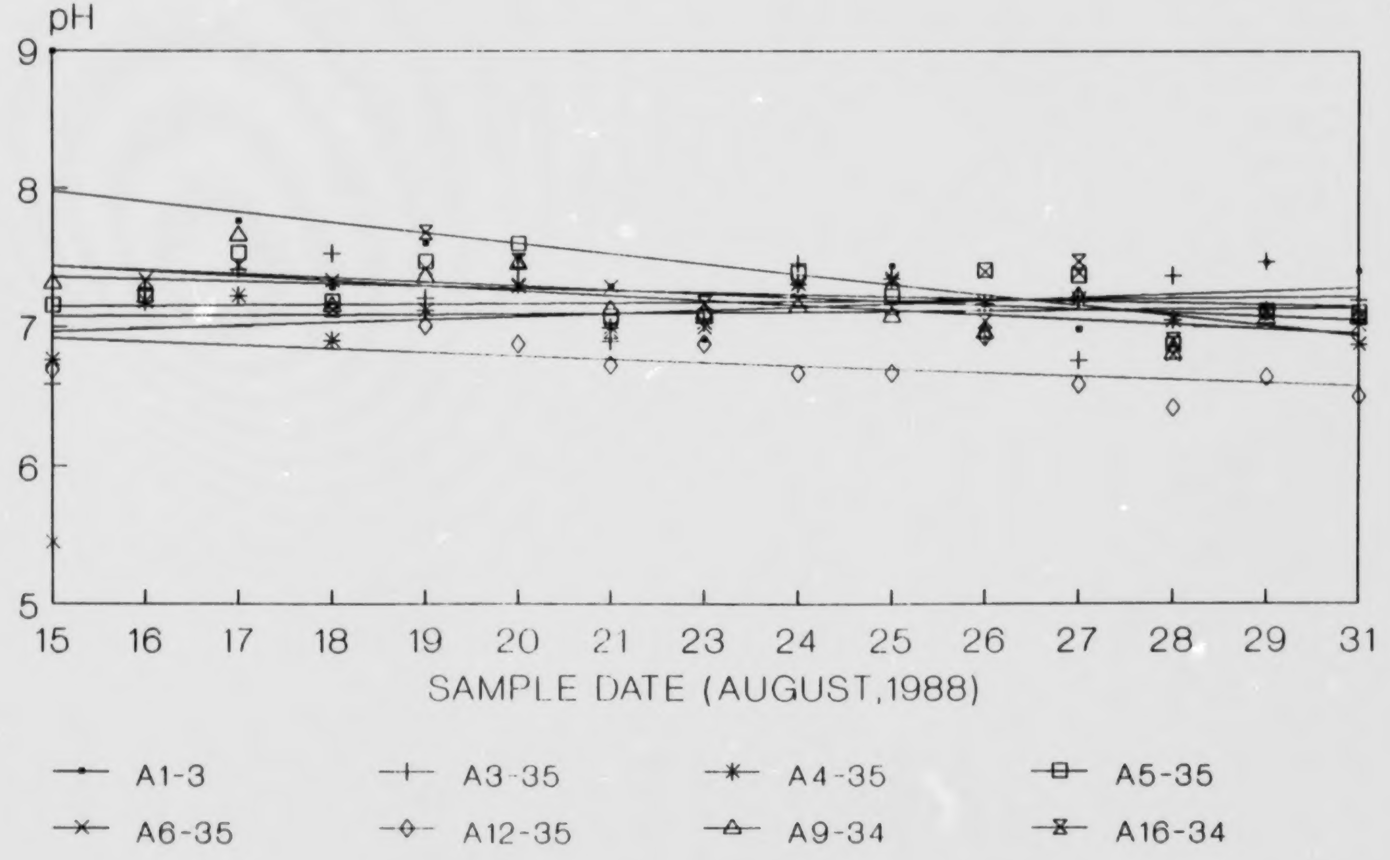
FIGURE 5 STANDARD HILL PRODUCED WATER SAMPLES - POST-INJECTION pH *



* DATA FROM CHANNEL WELLS

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FIGURE 6 STANDARD HILL PRODUCED WATER SAMPLES - BASELINE CONDUCTIVITY

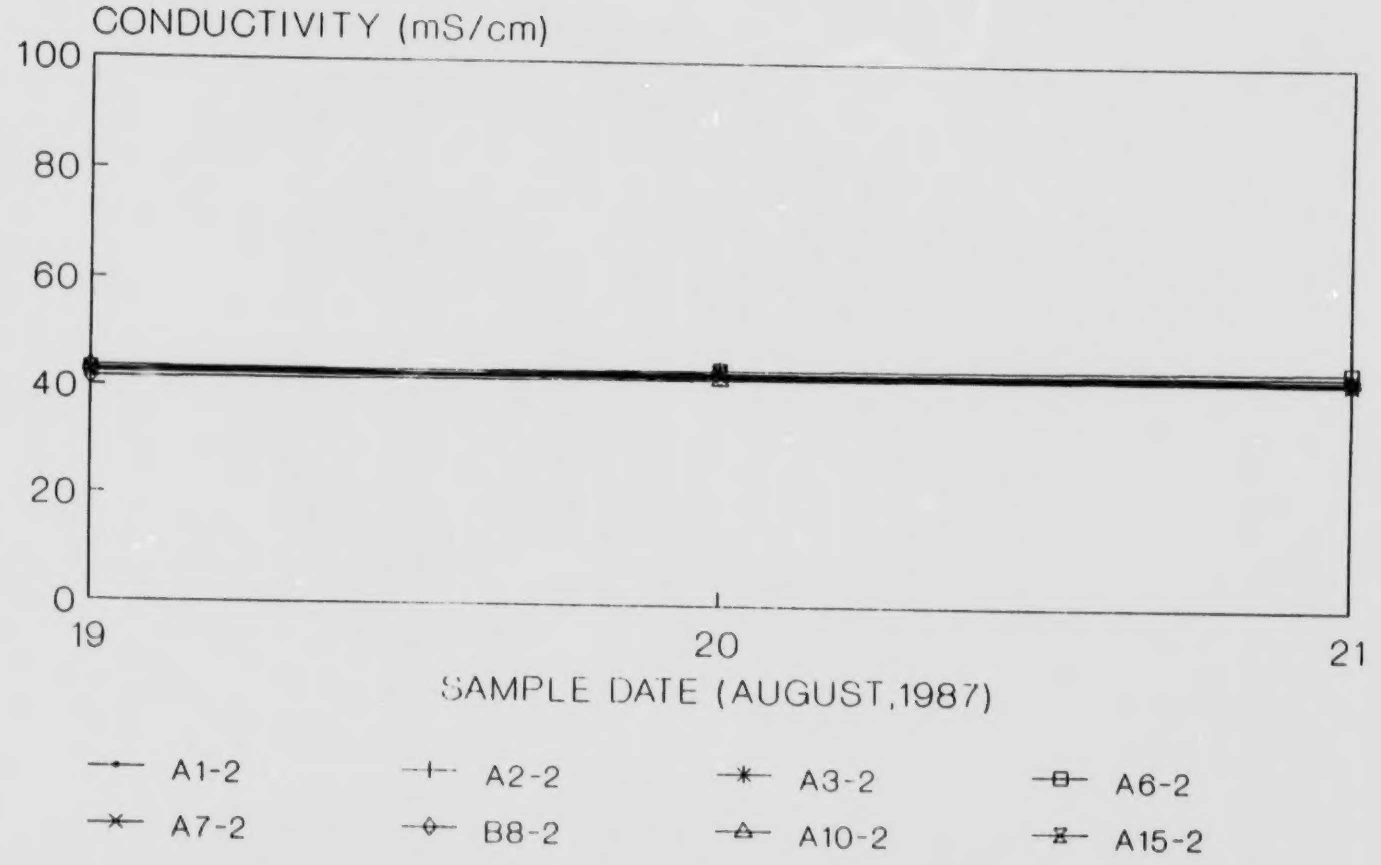

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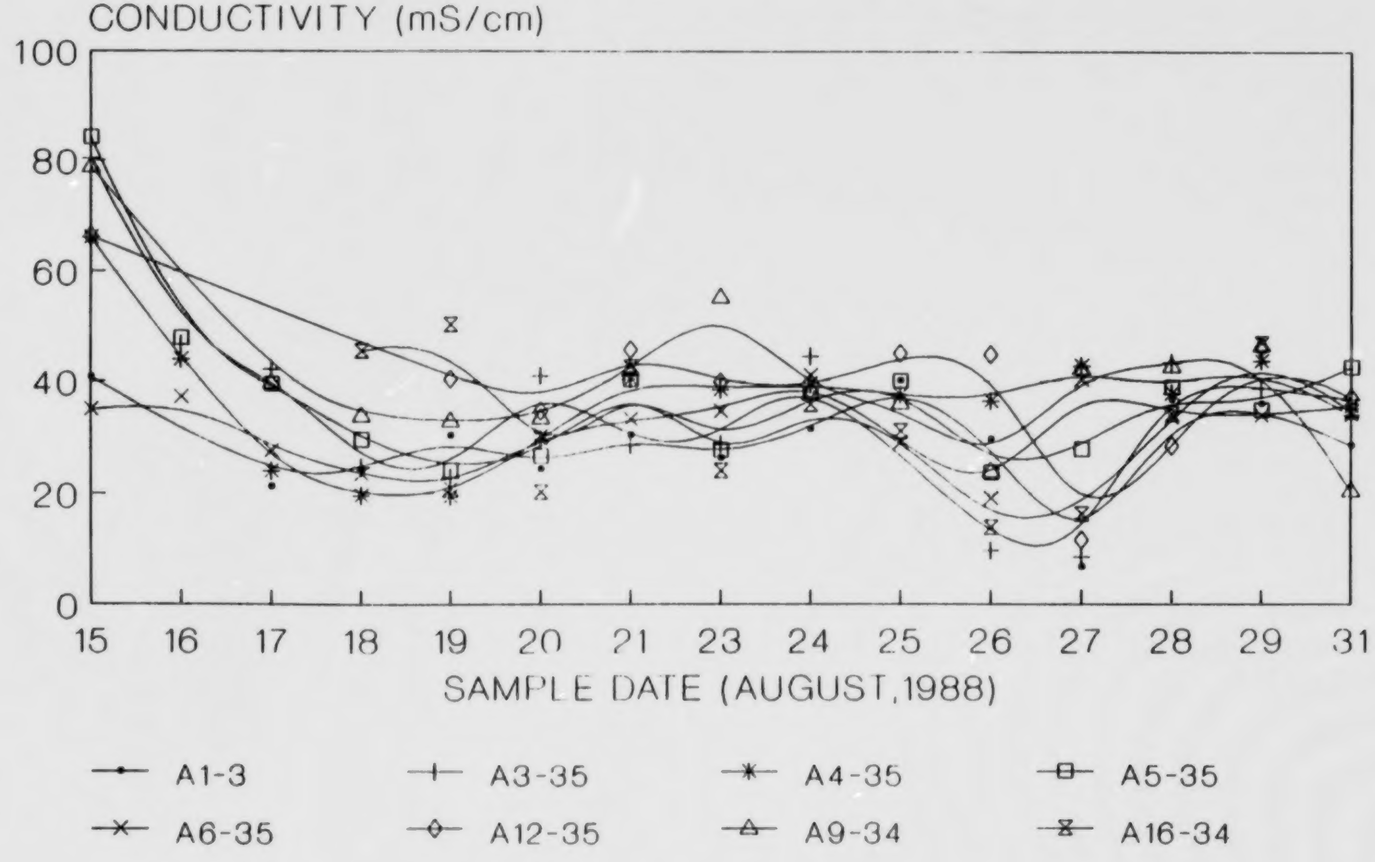
FIGURE 7 STANDARD HILL PRODUCED WATER SAMPLES - POST-INJECTION CONDUCTIVITY *



* DATA FROM CHANNEL WELLS

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FIGURE 8 STANDARD HILL PRODUCED WATER SAMPLES - BASELINE SURFACE TENSION

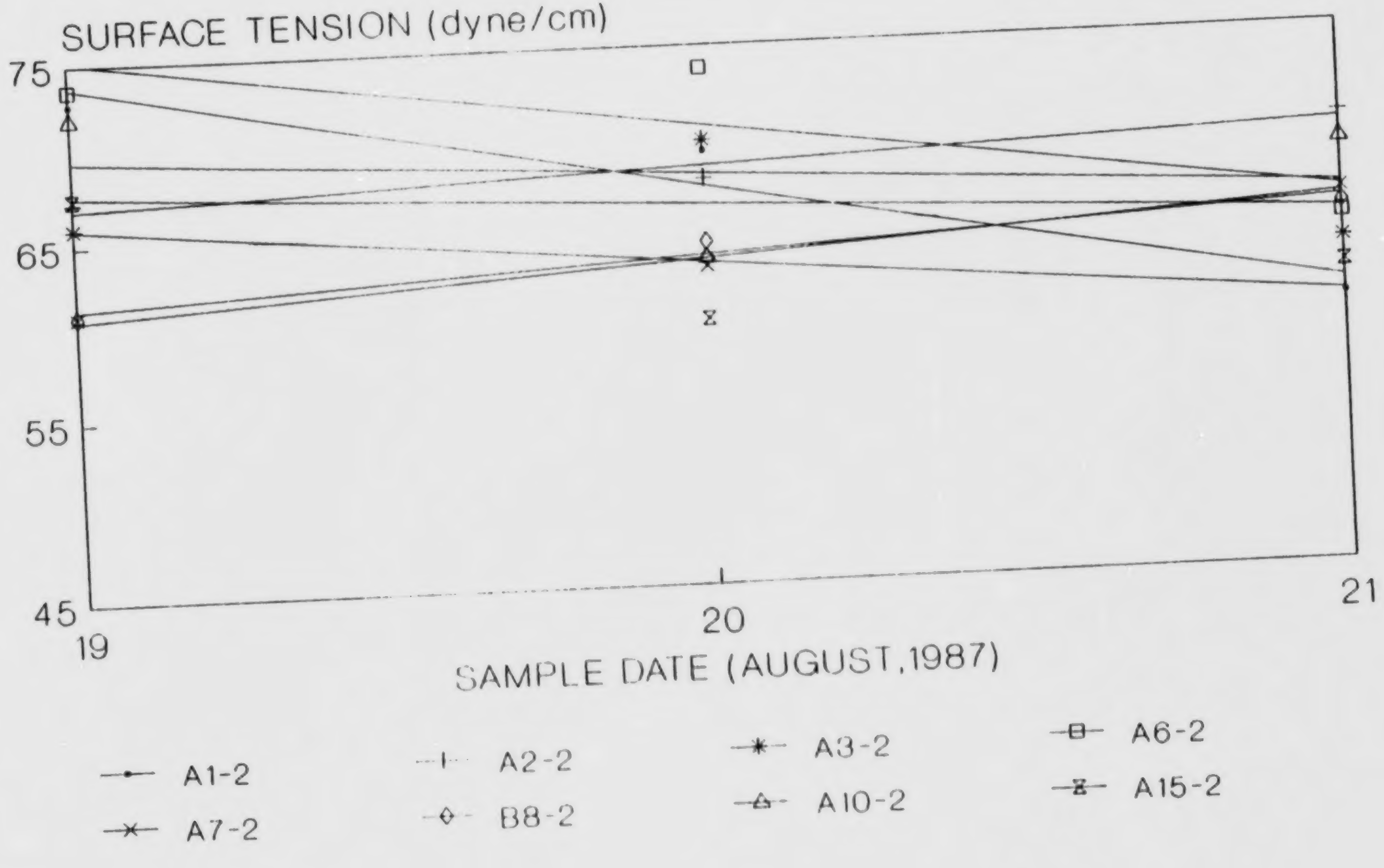

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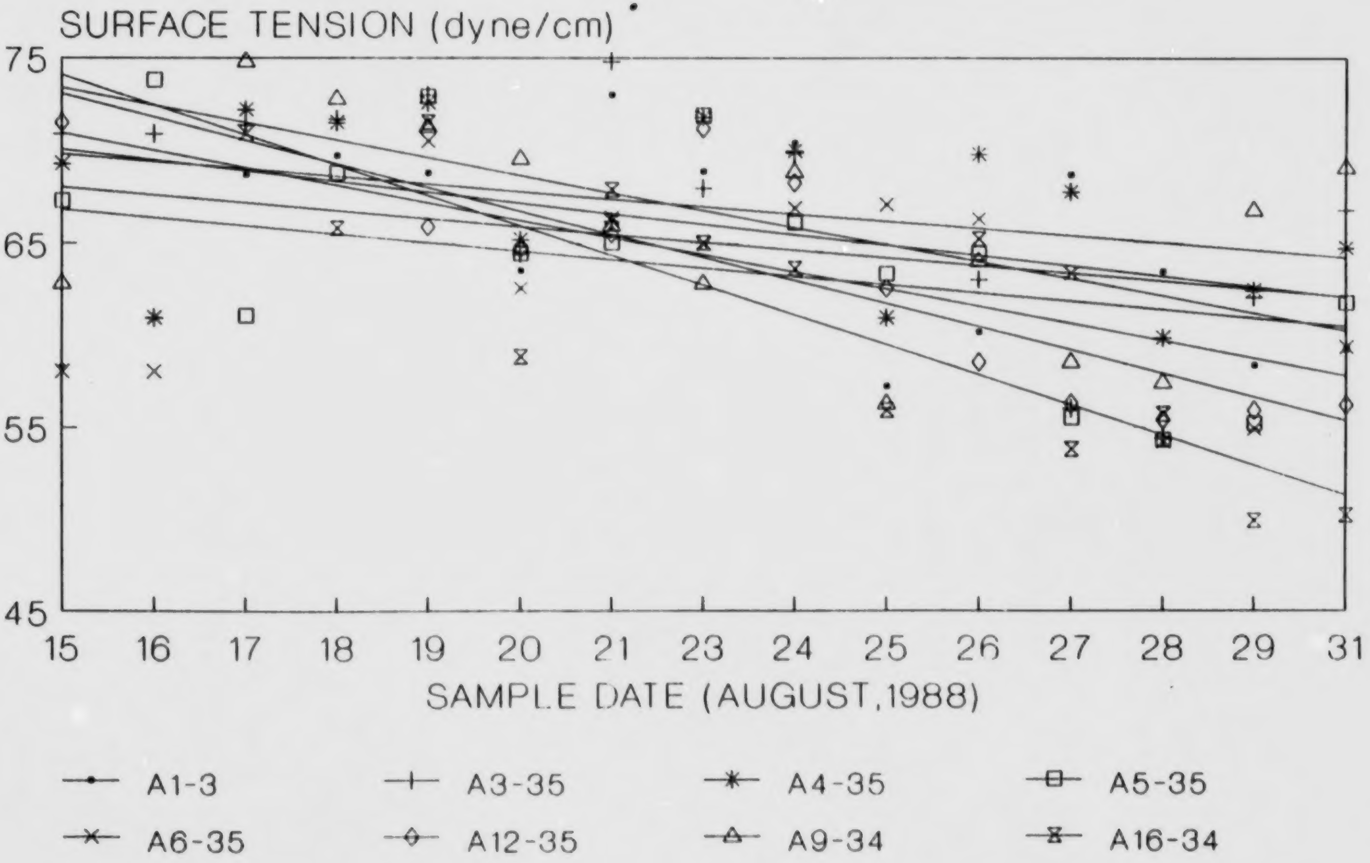
FIGURE 9 STANDARD HILL PRODUCED WATER SAMPLES - POST-INJECTION SURFACE TENSION *



* DATA FROM WELLS IN THE CHANNEL

FIGURE 10 STANDARD HILL PRODUCED WATER SAMPLES -
BASELINE TOTAL CATIONS AND ANIONS

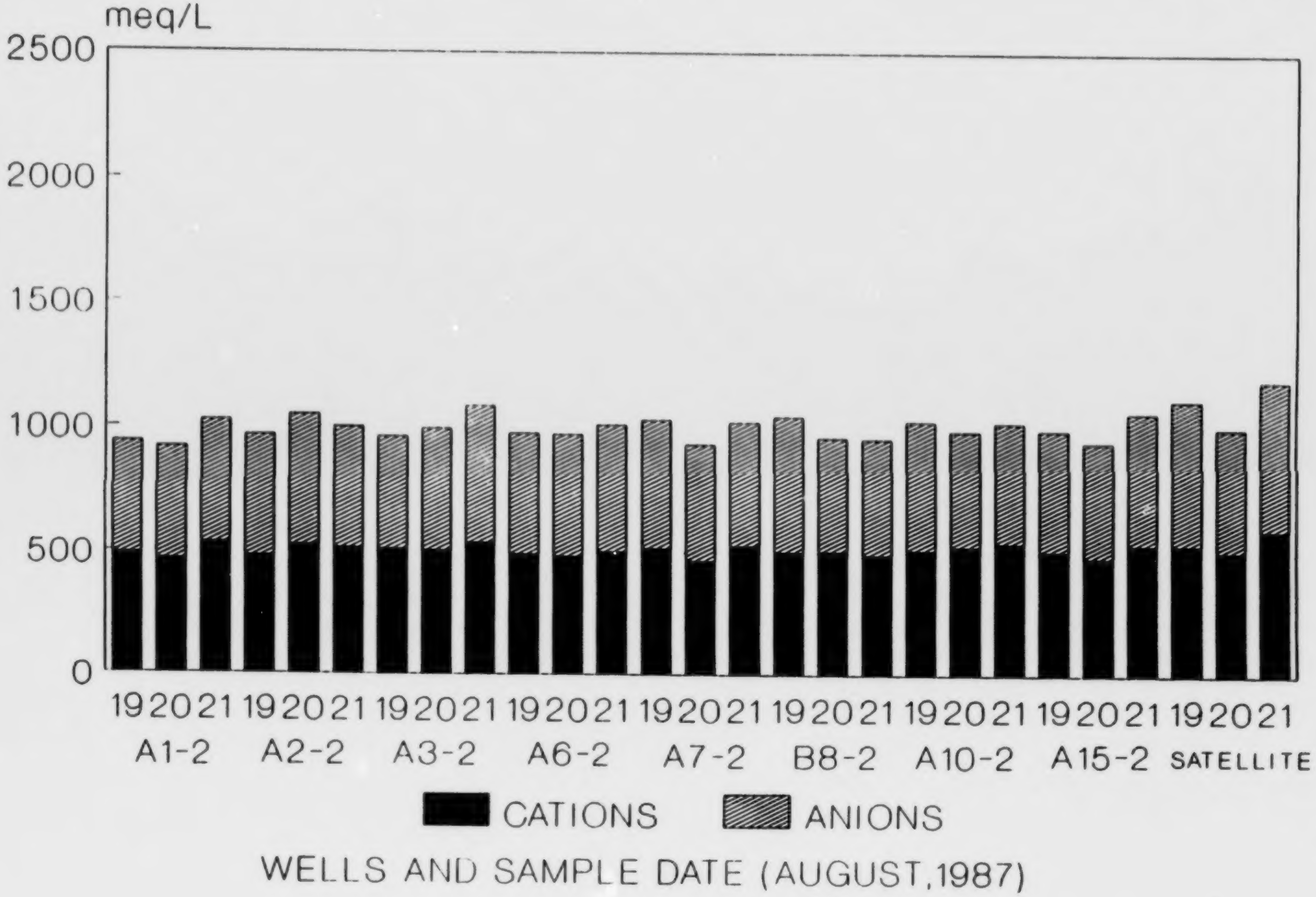


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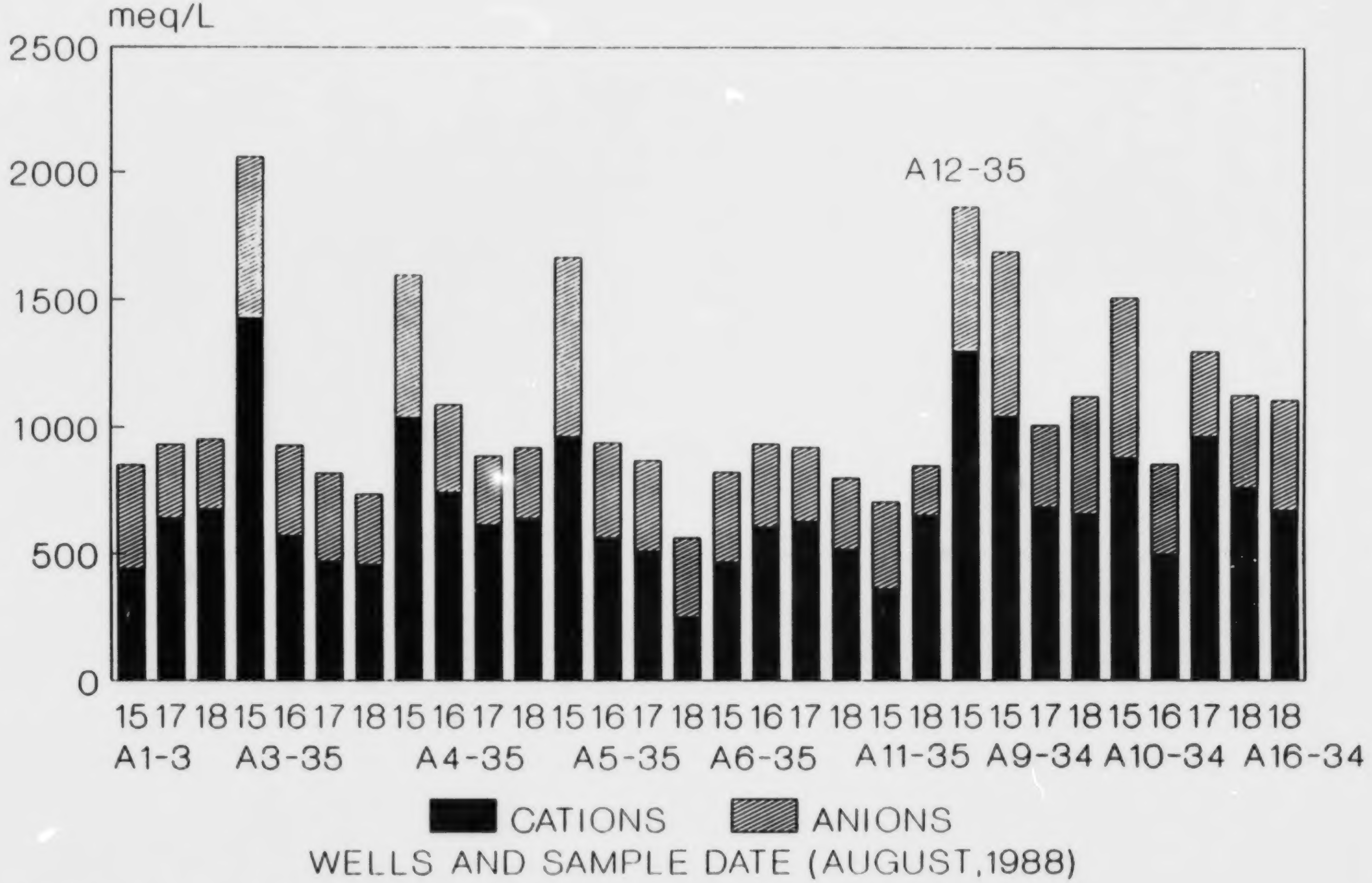
FIGURE 11 STANDARD HILL PRODUCED WATER SAMPLES - TOTAL CATIONS AND ANIONS *



* FIRST FOUR DAYS OF PRODUCTION

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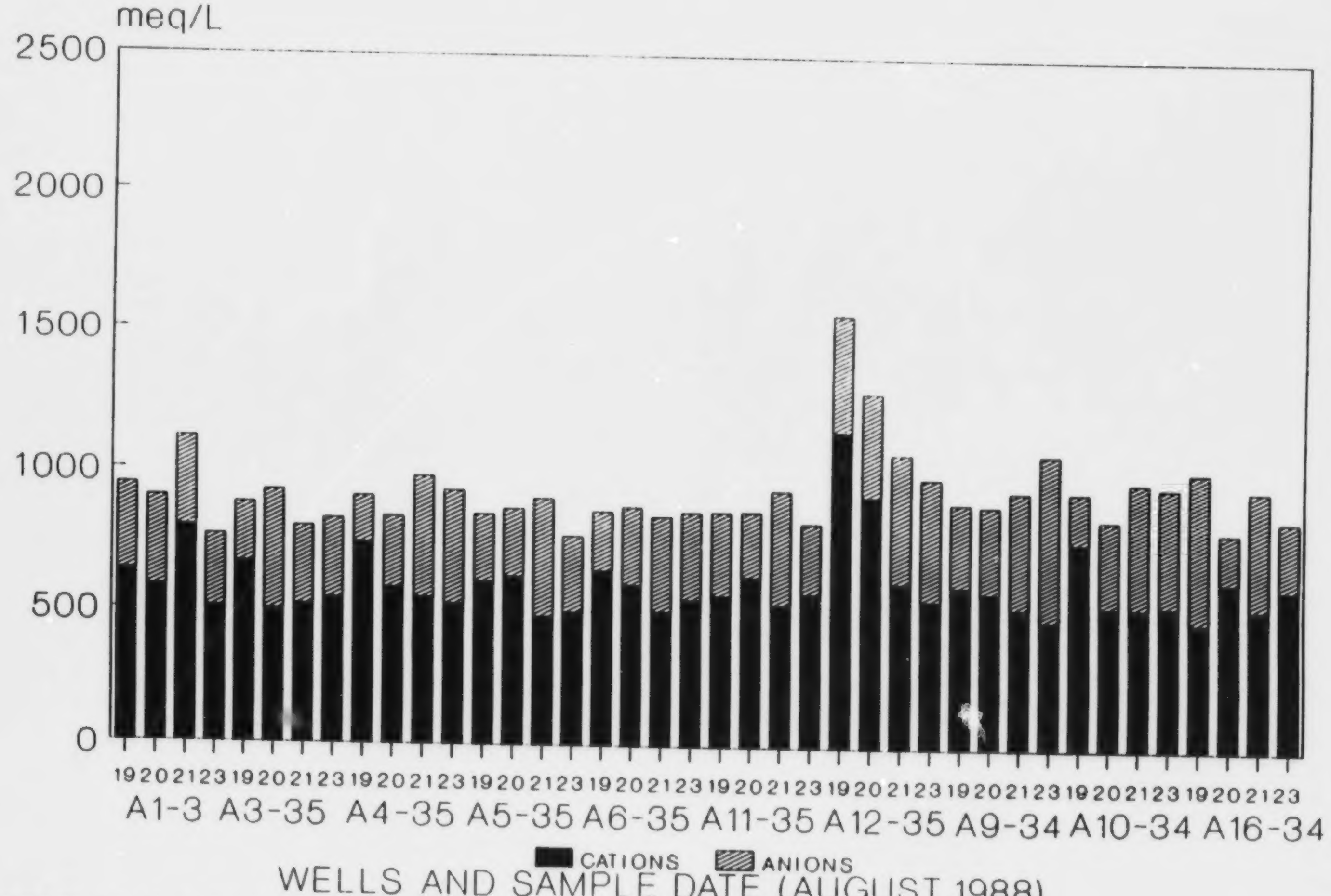
FIGURE 12 STANDARD HILL PRODUCED WATER SAMPLES - TOTAL CATIONS AND ANIONS *



* SECOND FOUR DAYS OF PRODUCTION

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FIGURE 13 BACTERIAL PRODUCED ALCOHOLS FROM STANDARD HILL

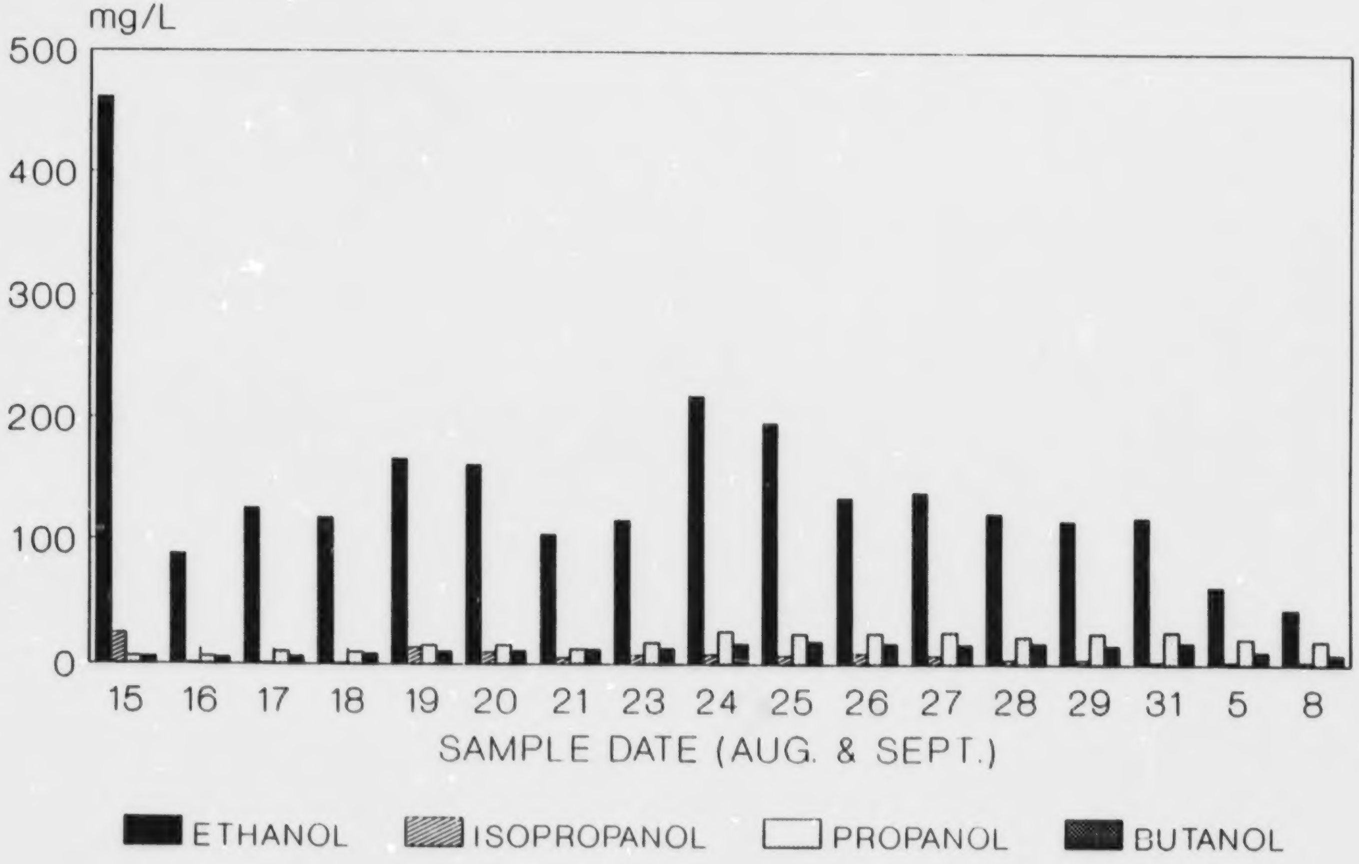

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FIGURE 14 BACTERIAL PRODUCED VOLATILE FATTY ACIDS FROM STANDARD HILL

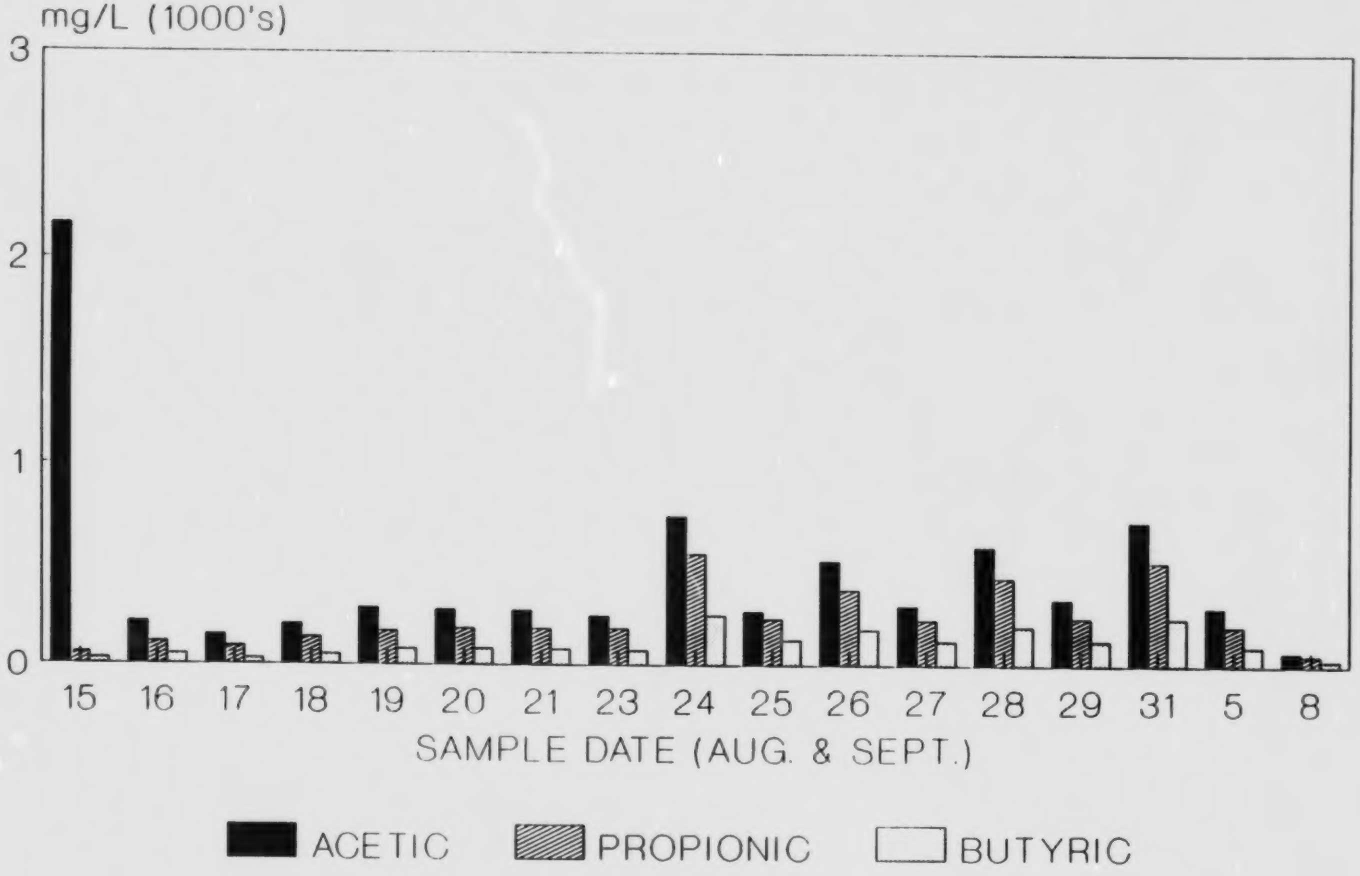

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FIGURE 15 LAB FERMENTATION PRODUCTS RECOVERED FROM WELL A6-35 ON AUGUST 15

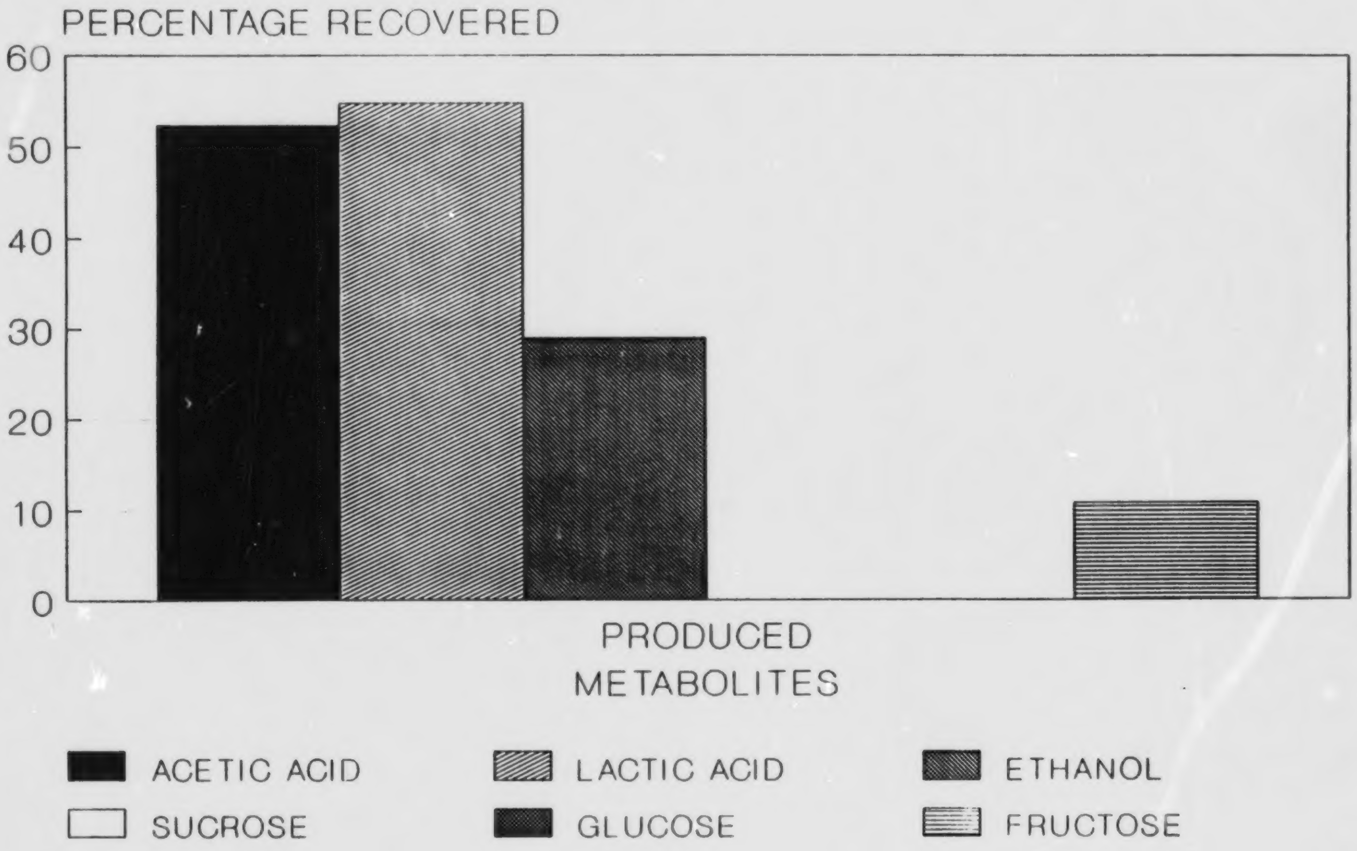

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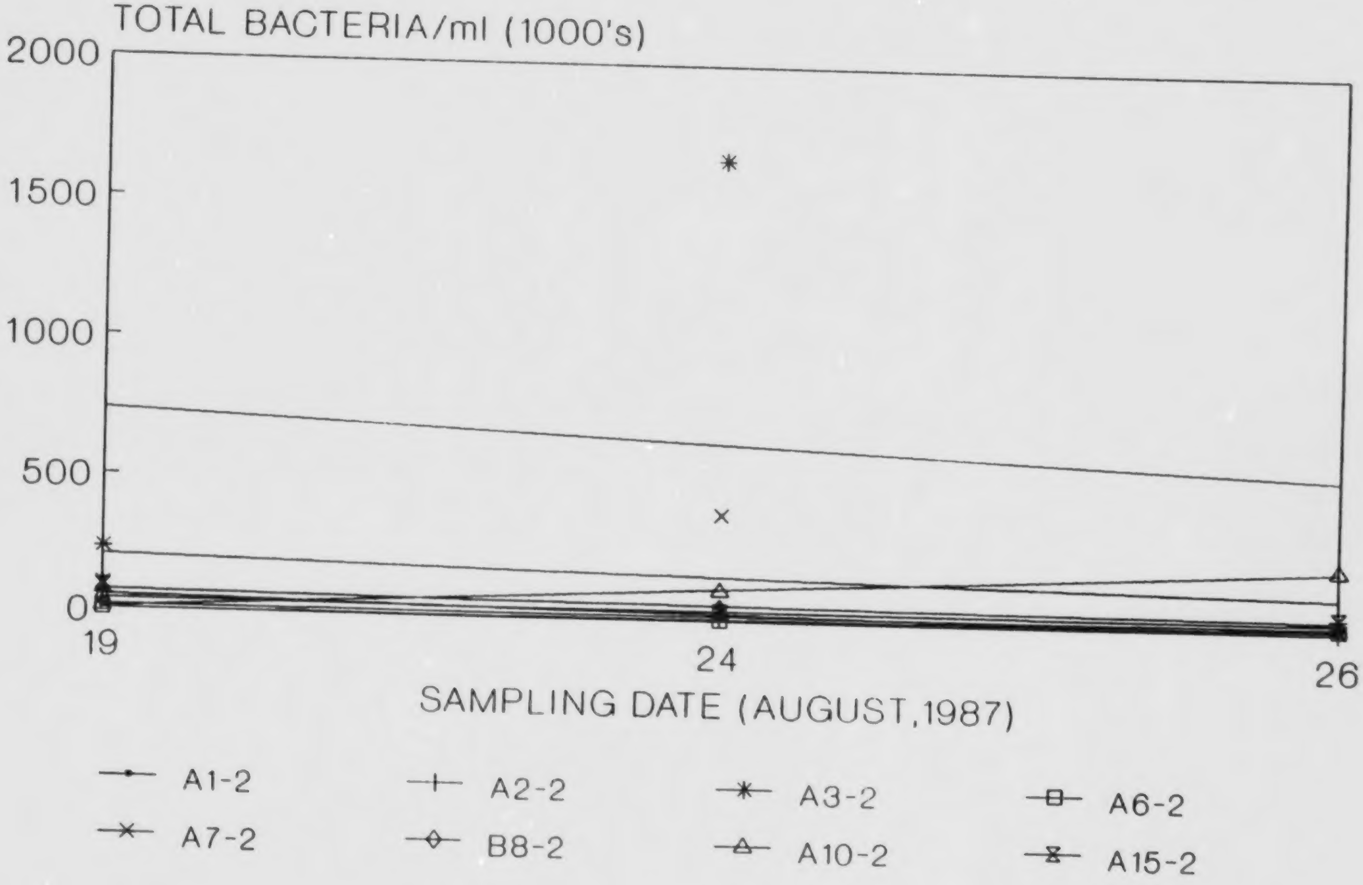
FIGURE 16 STANDARD HILL PRODUCED WATER SAMPLES - BASELINE BACTERIAL COUNTS *



* MOLASSES MEDIUM, ANAEROBIC INCUBATION

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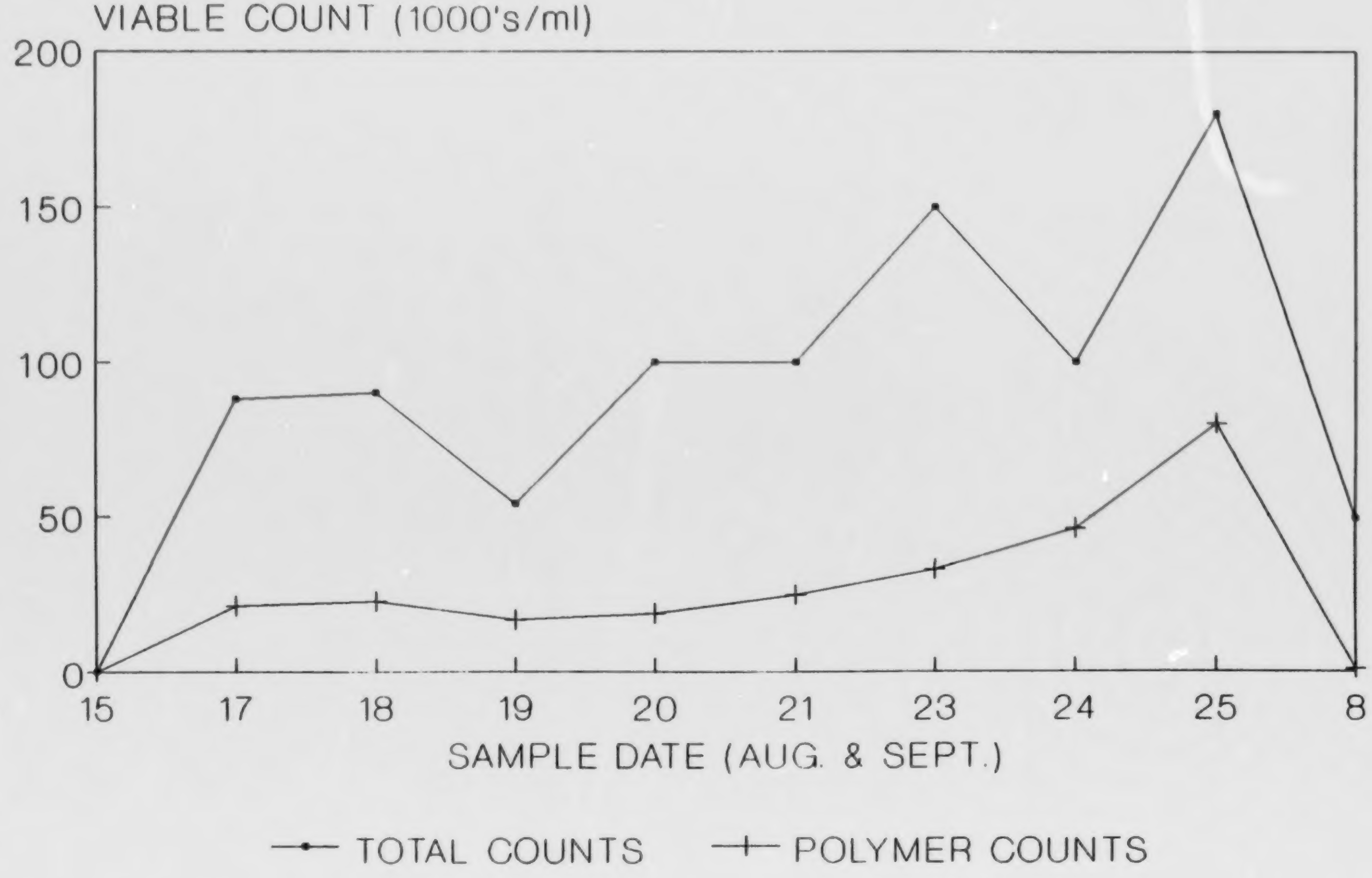
FIGURE 17 STANDARD HILL PRODUCED WATER SAMPLES - POST-INJECTION VIABLE COUNTS, A1-3 *



* MOLASSES MEDIUM, ANAEROBIC INCUBATION

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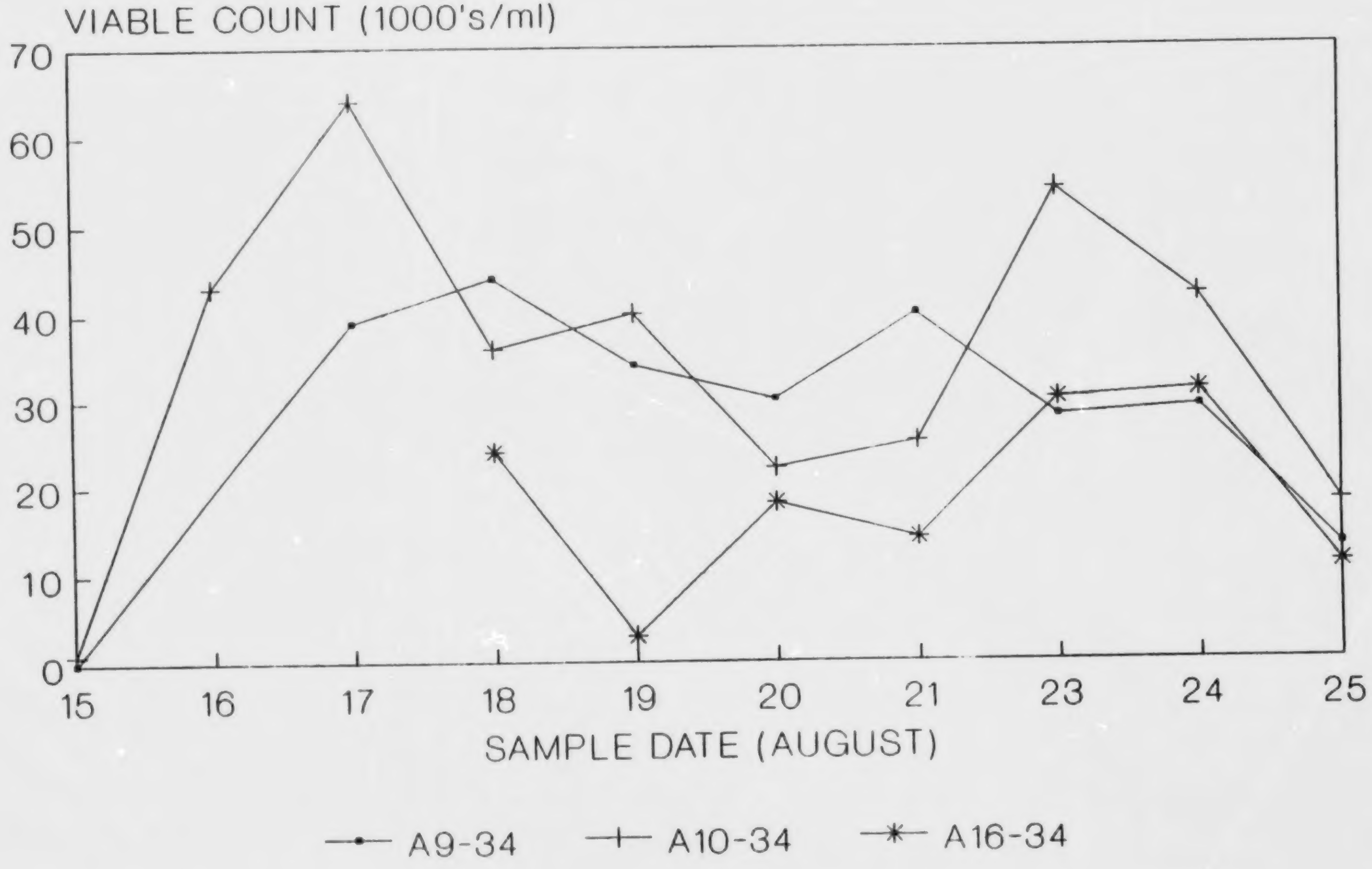
FIGURE 18 STANDARD HILL PRODUCED WATER SAMPLES - POST-INJECTION VIABLE COUNTS, SECTION 34 ·



· POLYMER FORMERS, MOLASSES MEDIUM, ANAEROBIC INCUBATION

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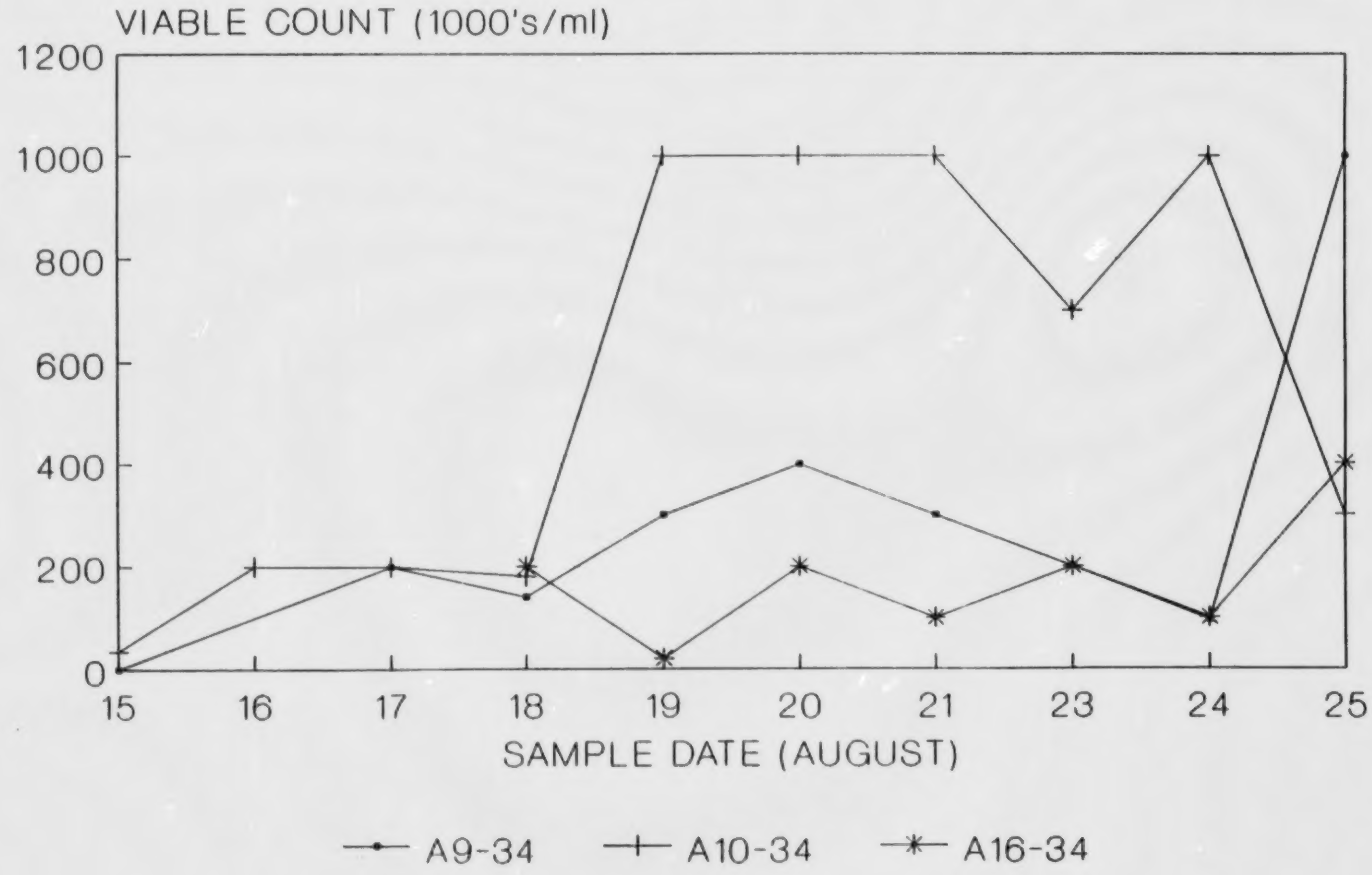
FIGURE 19 STANDARD HILL PRODUCED WATER SAMPLES - POST-INJECTION VIABLE COUNTS, SECTION 34 ·



· TOTAL COUNTS, MOLASSES MEDIUM, ANAEROBIC INCUBATION

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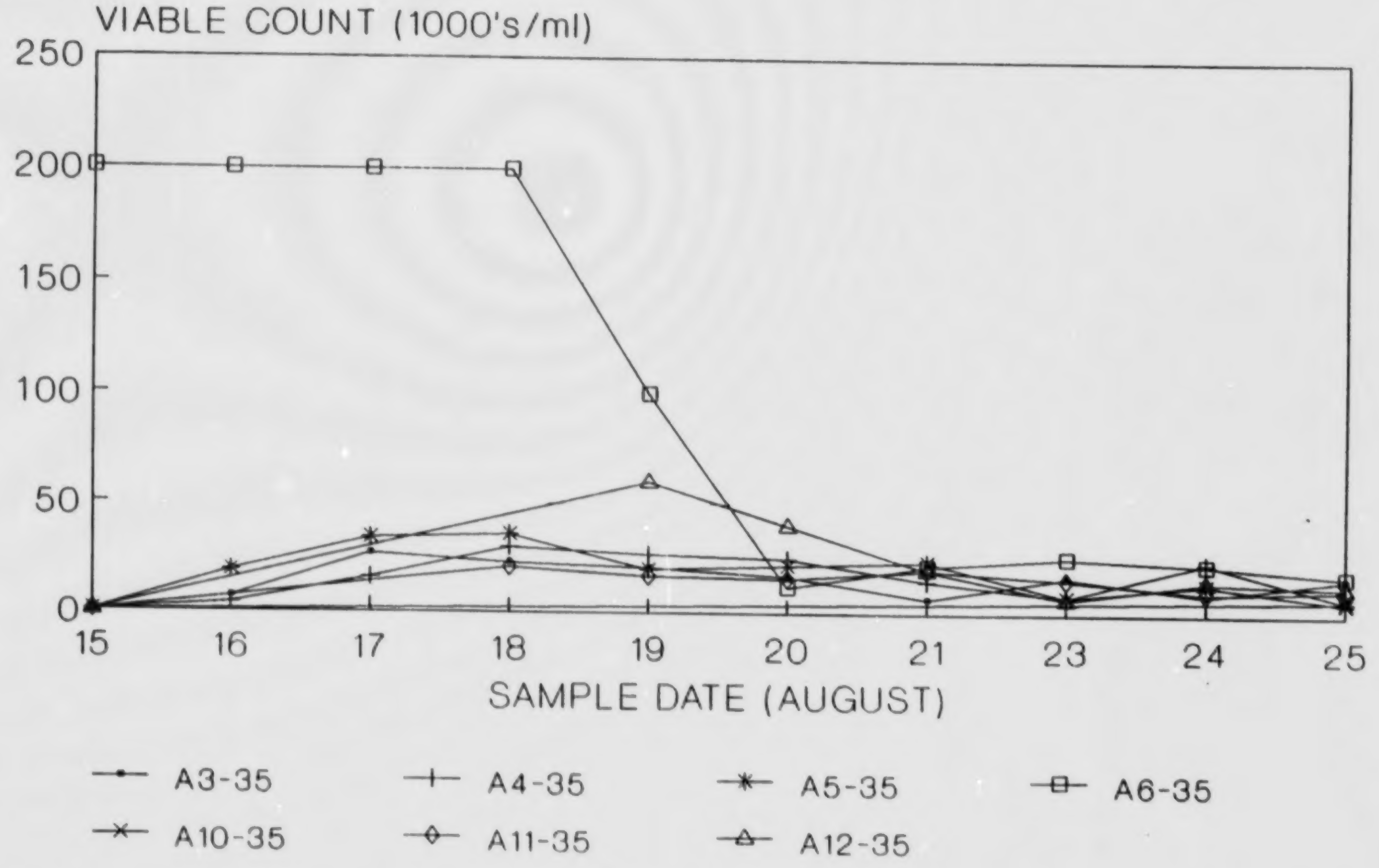
FIGURE 20 STANDARD HILL PRODUCED WATER SAMPLES - POST-INJECTION VIABLE COUNT, SECTION 35*



* POLYMER FORMERS, MOLASSES MEDIUM, ANAEROBIC INCUBATION

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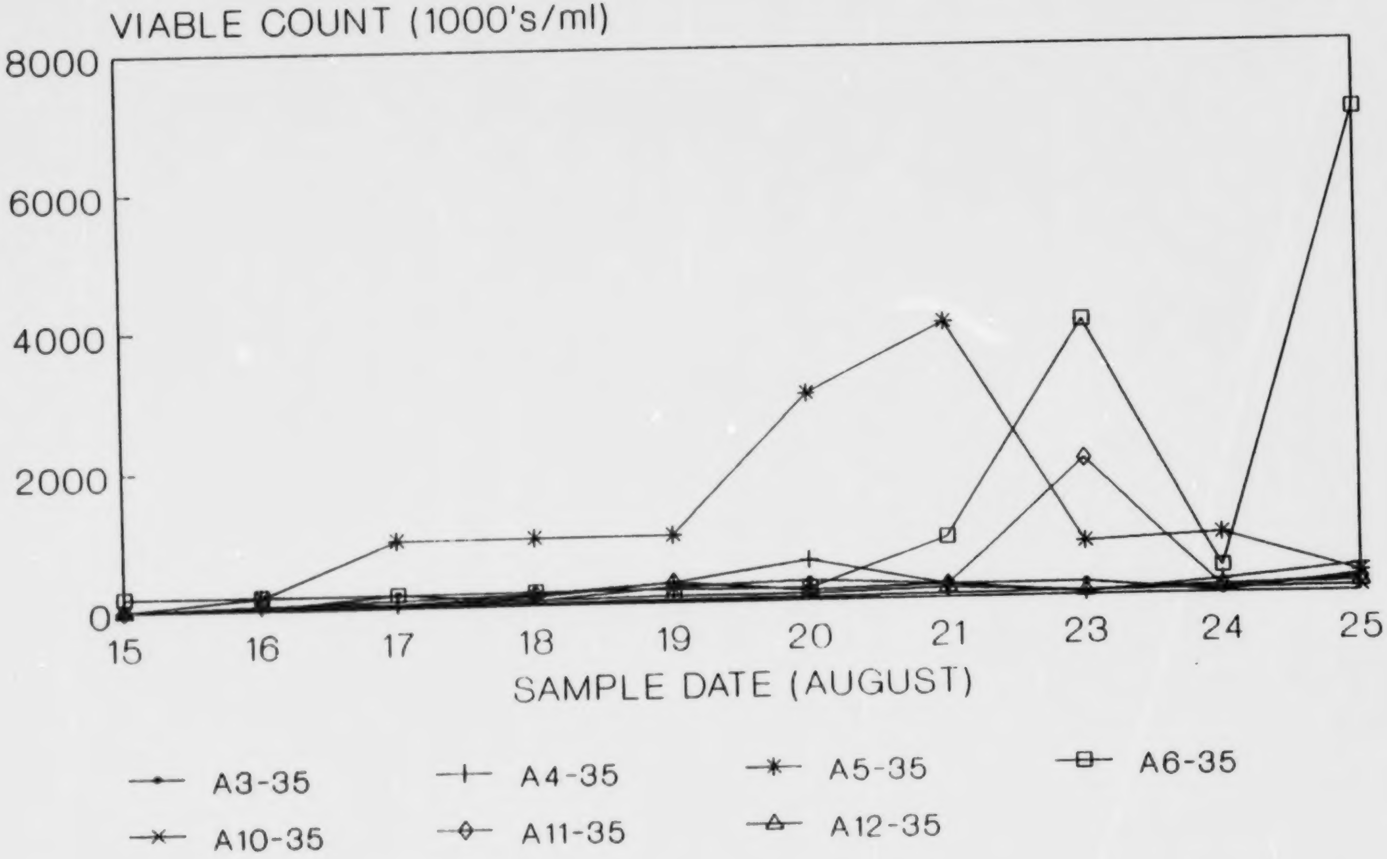
FIGURE 21 STANDARD HILL PRODUCED WATER SAMPLES - POST-INJECTION VIABLE COUNT, SECTION 35 *



* TOTAL COUNTS, MOLASSES MEDIUM, ANAEROBIC INCUBATION

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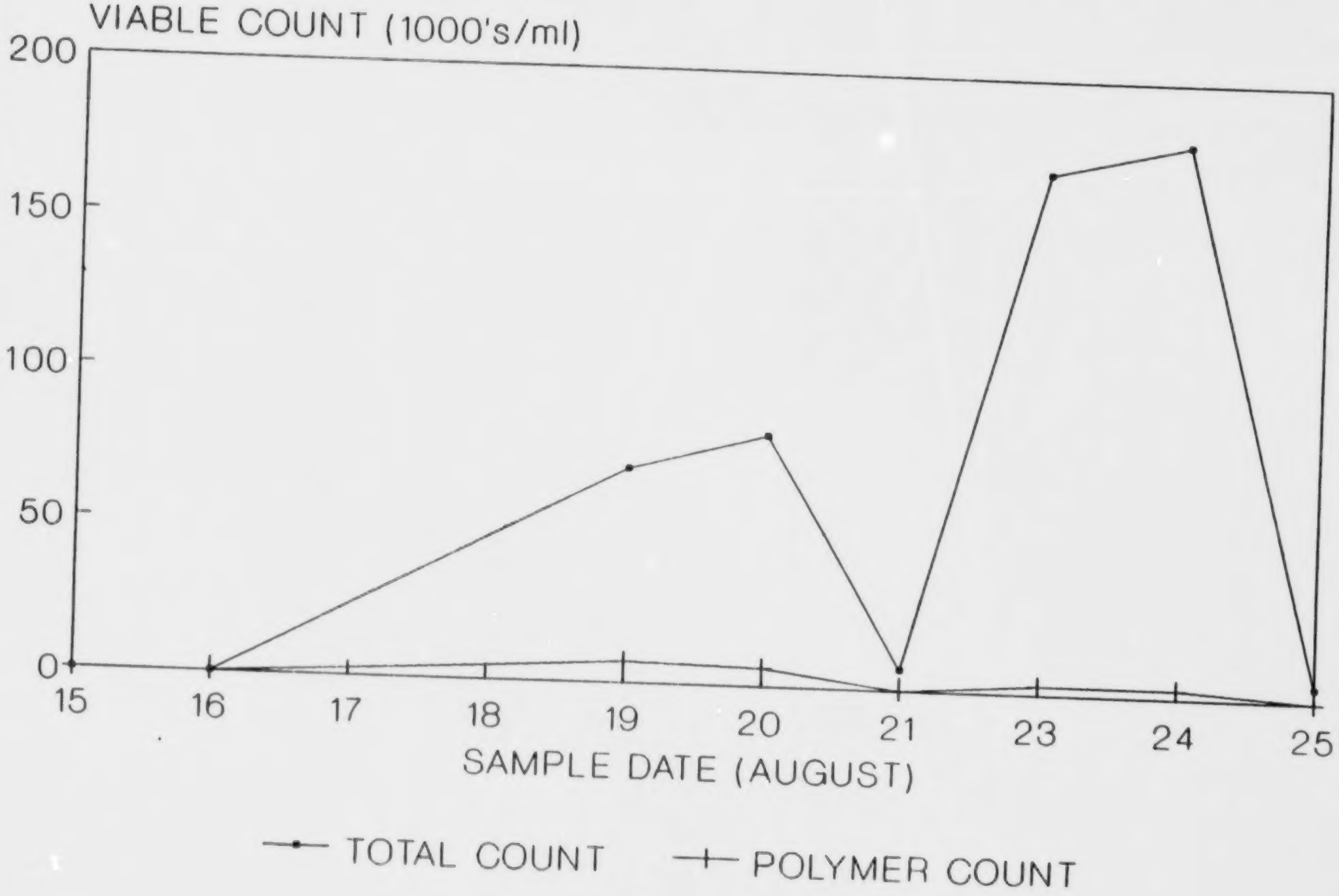
FIGURE 22 STANDARD HILL PRODUCED WATER SAMPLES - POST-INJECTION VIABLE COUNTS, SATELLITE ·



· MOLASSES MEDIUM, ANAEROBIC INCUBATION

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FIGURE 23 WELL LOCATION IN THE STANDARD HILL FIELD, HUSKY OIL LTD.

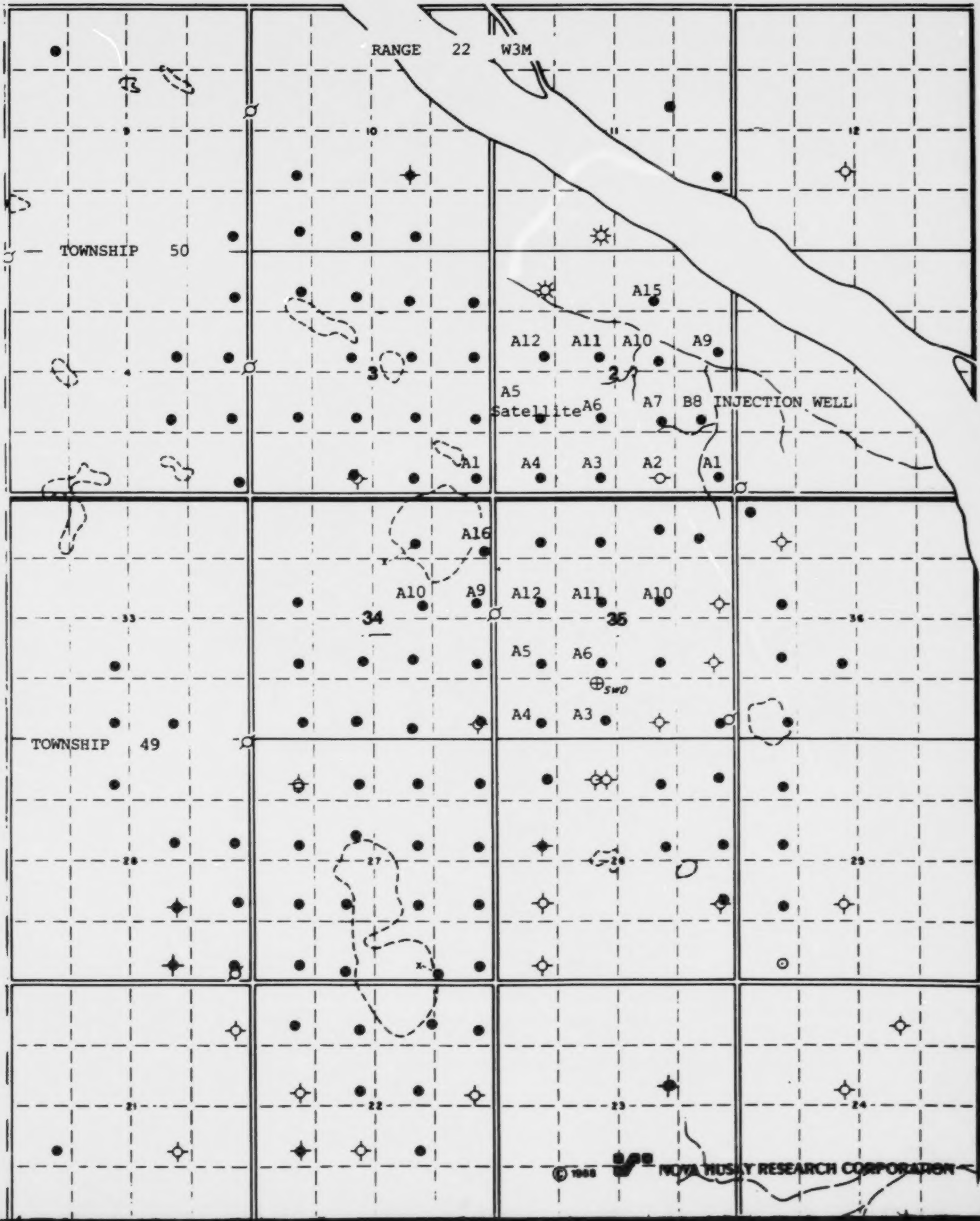
RANGE 22 W3M
TOWNSHIP 50
TOWNSHIP 49
9
10
11
12
3
2
34
35
33
36
28
27
26
25
21
22
23
24
A15
A12
A11
A10
A9
A5
Satellite
A6
A7
B8 INJECTION WELL
A1
A4
A3
A2
A1
A16
A10
A9
A12
A11
A10
A5
A6
SWD
A4
A3
© 1988 NOVA HUSKY RESEARCH CORPORATION

FIGURE 24 POST INJECTION WELLS AND NUMBER OF DAYS WHERE SIGNIFICANT REDUCTION IN CONDUCTIVITY OCCURRED

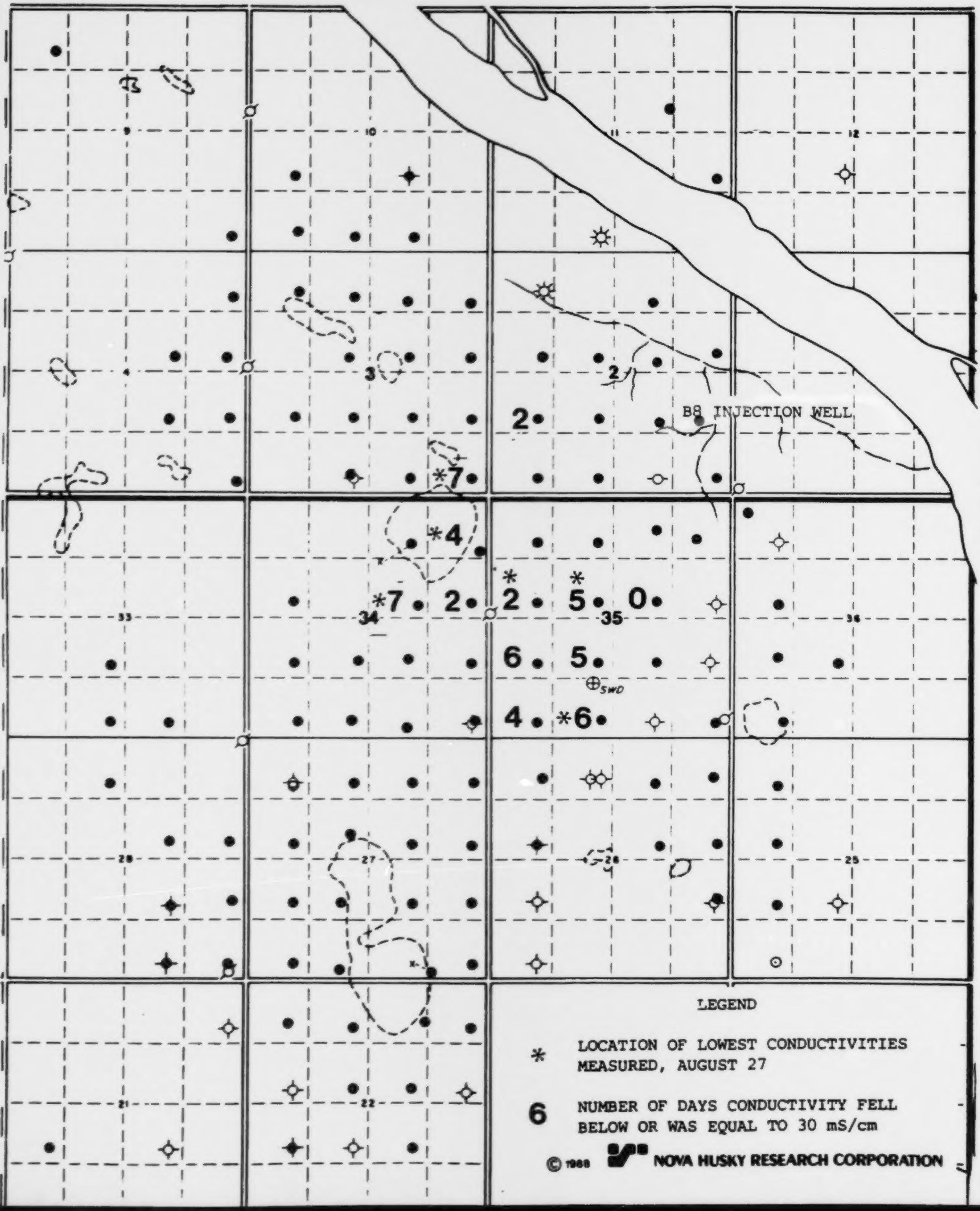
9
10
11
12
3
4
2
2
B8 INJECTION WELL
*7
*4
*7
2
2
5
0
34
35
33
36
6
5
SWD
4
*6
28
27
26
25
21
22
LEGEND
* LOCATION OF LOWEST CONDUCTIVITIES MEASURED, AUGUST 27
6 NUMBER OF DAYS CONDUCTIVITY FELL BELOW OR WAS EQUAL TO 30 mS/cm
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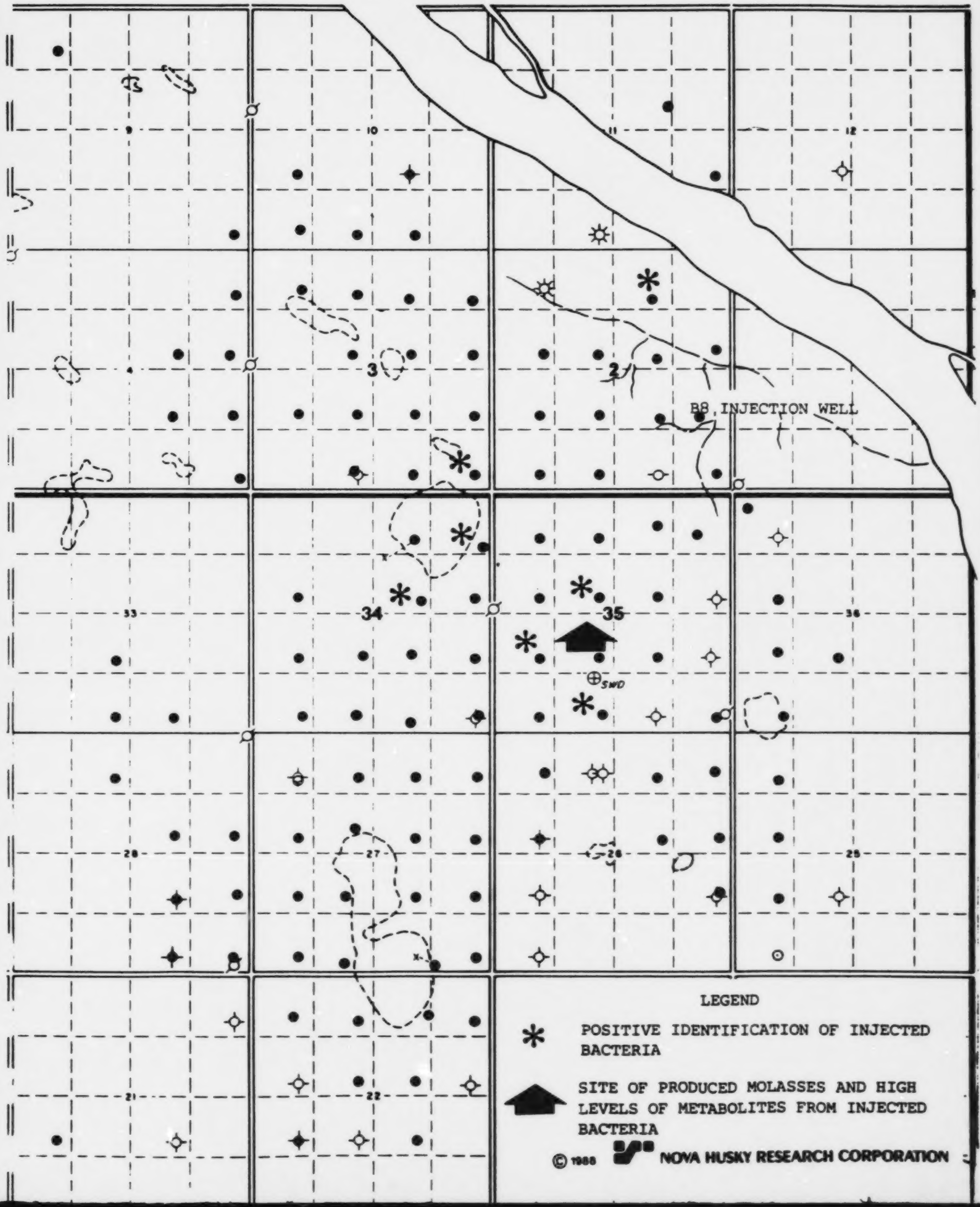
FIGURE 25 POST INJECTION WELLS WHERE POSITIVE IDENTIFICATION OF INJECTED BACTERIA WAS MADE BY FATTY ACID ANALYSIS


9
10
11
12
3
2
B8 INJECTION WELL
33
34
35
36
SWD
28
27
26
25
21
22
LEGEND
* POSITIVE IDENTIFICATION OF INJECTED BACTERIA
SITE OF PRODUCED MOLASSES AND HIGH LEVELS OF METABOLITES FROM INJECTED BACTERIA
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APPENDIX A

REPORT FROM ALBERTA DISTILLERS LIMITED ON INOCULUM PREPARATION

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Alberta Distillers Limited

P.O. BOX 5100, POSTAL STATION A, CALGARY, ALBERTA T2H 1X1

August 8, 1988

SCALE-UP OF A LEUCONOSTOC MESENTEROIDES CULTURE

INTRODUCTION: A culture of *L. mesenteroides* was scaled up from 5 - 10 mls at 200 x 10^6 cells per ml to 20,000 litres at 200 x 10^6 cells per ml. This scale-up involved three sub-culturing steps, each providing a twenty-four hour incubation period. A fourth step was necessary to bring the final volume up to 20,000 litres. The objective of each incubation period was to obtain a live cell density of 200 x 10^6 cells per ml. This would then be used as inoculum for the next step.

METHOD: Materials provided by Nova Husky (Table 1) were used to make up media for the three reactors used. The pH adjustment was made with concentrated hydrochloric acid after a suitable mixing time was allowed for all ingredients to dissolve. Sterilization was carried out at 121°C for one hour on all media prepared.

.../2

Table 1

Media Composition

Glucose	0.2%
Tryptic Soy Broth	0.2%
Yeast Extract	0.2%
Dipotassium Phosphate	0.2%
Hydrochloric Acid (conc)	to a pH of 7.0
(Microferm - 5 litres	2.5 mls)
(Seed Tank - 1,700 litres	300.0 mls)
(Reactor - 13,000 litres	3000.0 mls)
Deionized Water	to required volume

Figure 1 shows the sequence of steps followed, as well as the expected cell count at the end of each incubation period.

Figure 1

Scale-Up of L. mesenteroides Culture

Stock Culture 5 - 10 mls @ 200 x 10^6

↓

Step (1) Microferm Jar - 5 litres
- Incubate 24 hrs. @ 30°C
to a count of 200 x 10^6 cells/ml

↓

Step (2) Seed Reactor - 1,700 litres
- Incubate 24 hrs. @ 30°c
to a count of 200-400 x 10^6 cells/ml

↓

Step (3) Reactor - 13,000 litres
- Incubate 12 - 14 hrs. @ 30°C
to a count of 200-400 x 10^6 cells/ml

Step (4) Add 7,000 litres sterile media to the
13,000 litres for a total of 20,000 litres
@ 130-260 x 10^6 cells/ml

Both direct (microscope) and plate counts (molasses agar) were made at the completion of each incubation phase.

RESULTS: The results of the direct and viable counts made on the three reactor sizes are shown in Table 2.

Table 2

Cell Counts Obtained at the Three Scale-Up Levels

Reactor Volume	Inoculant Volume @ $200x10^6$ cells/ml	pH		Final Count (cells/ml)		
		Ohrs.	Final	Age (Hrs.)	Direct	Plate
5 L	10 mls	6.8	N.D.	22	$169x10^6$	N.D.
1,700 L	5 L	6.8	4.9	23	$224x10^6$	$325x10^6$
			4.8	27	$171x10^6$	$400x10^6$
13,000 L	450 L	6.5	5.05	12.5	$183x10^6$	$160x10^6$
			N.D.	14.5	$207x10^6$	N.D.

CONCLUSIONS: Based on the live count obtained in the 13,000 litre reactor, addition of 7,000 litres to the 13,000 litres resulted in 20,000 litres with a live cell count of 104×10^6 cells/ml (assuming that the live count did not change in the time it took to prepare the 7,000 litres).

Repeated microscopic examination of the cultures throughout the entire scale-up procedure showed only the characteristic L. mesenteroides cells, indicating that the purity of the culture was maintained.

L Richardson

L. Richardson
Plant Microbiologist

LR/yv

APPENDIX B

DETAILED FIELD TEST INJECTION REPORT

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OCT 24 1988

MEMORANDUM

August 10, 1988

TO: P. W. Breen

FROM: S. E. Payne

SUBJECT: Standard Hill Biopolymer Project
Field Injection (Task 7)

The field injection phase of the Standard Hill Biopolymer Plugging Test was carried out July 30, 31 and August 1, 1988. Injection was carried out at B8-2-50-22 W3M, located on the north-east edge of the field. There were no significant problems or delays, and the injection program proceeded as planned. Details of the injection were as follows:

1) Buffered Water Preparation:

On Friday, July 29, 21 drums (950 kg) of Anhydrous Piperazine were dissolved in $210m^3$ of fresh water. The pH was adjusted down using 1 074 liters (1 265 kg) of 35% HCl. Nowsco Well Services provided a Jet-Mixer to mix the chemicals with the water and supplied the 35% HCl. The fresh water had been hauled in from Pike's Peak Battery, and was stored in two $120m^3$ water tanks on the B8-2 lease.

Mixing of Tank #1 commenced at 10:00 a.m. and was completed at 5:00 p.m. The Piperazine had absorbed moisture during storage and was in a solid mass rather than a granular form; so it had to be chipped and pounded out of its drums. The Piperazine dissolved easily in water, but the subsequent pH adjustment using HCl was very slow (5.0 hrs.) due to problems encountered trying to achieve circulation and complete mixing in the field tanks. The HCl, being heavier than water, tended to stay at the bottom of the tank. The final pH of Tank #1 was 6.7 (top and bottom) and 549 liters (647 kg) of HCl were consumed.

Mixing of Tank #2 commenced at 5:30 p.m. and was completed at 11:25 p.m. Again the pH adjustment was a slow process (4.7 hrs). After 2 hrs of circulating, the return line was moved 2m off the bottom of the tank to the top, this helped to improve the mixing action. The final pH of Tank #2 was 7.5 (top) and 6.8 (bottom). 525 liters (618 kg) of HCl were consumed.

The allowable pH range of the buffered water was 6.8 - 7.1. Average of both tanks during injection on Sunday was 7.04.

.../2

2) Injection of Sacrificial Agent:

The 20m³ of Sacrificial Agent (Pulp Mill Effluent) arrived 12:30 a.m., July 30, from Hinton. The truck and trailer were rigged into the injection point and left to sit overnight to allow the fibrous material in the load to settle out.

Injection commenced at 8:45 a.m. Saturday, with a target rate of 40 L/min. A 2L4 Moyno pump was used to suck off the top of the trailer and inject the Sacrificial Agent through a series of four filter pots. Each pot contained 3 filters, the 1st pot held 30 micron Polypure filters, the 2nd contained prefilters with a nominal rating of 3 microns, the 3rd held 3 micron Polypure filters and the 4th held 0.6 micron Polypure filters. The pressure drops across each pot were monitored throughout the injection as the filters would plug at a ΔP of 80 psi. The 0.6 micron filters showed signs of plugging almost immediately. By 9:30 a.m. we had achieved a 70 psi drop across the 4th pot, so injection was shut down and the 0.6 micron filters replaced. The 2nd set of 0.6 micron filters lasted almost 2 hours before reaching a ΔP of 80 psi. At 11:00 a.m. we removed the 0.6 micron filters and by-passed the 4th filter pot.

Injection was completed at 6:00 p.m. The wellhead pressure remained at 0 kPa throughout and the well was taking some fluid on vacuum. A valve on the pump intake was used to choke back the flowrate. No pressure drops occurred across the remaining three filter pots through the injection period. The Floco meter registered 22.05m³ when the tank was empty. The average injection rate was 44 L/min.

3) Bleach flush:

At 6:45 p.m., following injection of the Sacrificial Agent, we pumped a 10m³ spacer of fresh water at approximately 1m³/min and 0 kPa at wellhead. This was followed by 2.05m³ of bleach (12% Sodium Hypochlorite). The bleach was used to sterilize the surface lines and tubing prior to the Inoculum injection. It was sucked into a vacuum truck from barrels and pumped from the truck through the surface lines and downhole.

At 7:15 a.m. the following morning, July 31, we displaced the bleach into the formation using 10m³ of 10 micron filtered, UV sterilized, fresh water pumped by a water truck at an average rate of 196 L/min. Injection through the Ultraviolet (UV) water Sterilizer was limited to a rate of 200 L/min.

4) Inoculum Injection:

The truck hauling the 20m³ of Inoculum (Leuconostoc Bacteria) from Alberta Distilleries in Calgary arrived on lease at 8:30 a.m. Sunday, July 31.

.../3

We first attempted to inject the bacteria down the surface lines but a 1" turbine meter in the line created a pressure build up and the Trimac truck's pump could not pump against the pressure. We then moved the truck and injected directly down B8-2's wellhead. Injection took approximately 1 hour with no pressure build up at the wellhead. Bacteria injection was completed at 10:25 a.m.

At 11:00 a.m. we commenced pumping five 2m³ slugs of buffered, 10 micron filtered, UV sterilized fresh water. An 18-24 Wheatley Piston pump was used to inject the buffered water from the tanks on lease. B8-2 took approximately 70 L/min of water on vacuum prior to starting up the pump. Again the injection rate was limited to 200 L/min by the UV sterilizer. Each slug took 10 minutes to inject and we waited 5 minutes between slugs. This slugging process was used to push the bacteria out into the formation, because it tends to stick.

5) Sucrose - Water Injection:

A sucrose-water solution was injected following the Inoculum to provide food for the bacteria. 44 000 kg of a mollases/sucrose blend (57.3% sucrose) was ordered from the Alberta Sugar company in Tabor. This was to be line mixed with the buffered water to provide approximately a 12% sucrose (by weight) solution. Based on a mollases/sucrose density of 1.3m kg/m³, optimum injection rates were calculated to be 200 L/min for the buffered water stream and 41 L/min for the sucrose/mollases stream.

The two Trimac trucks hauling the mollases/sucrose solution arrived on lease at 8:10 a.m., Sunday morning, July 31. The trucks were to be staggered 6 hours apart, but were sent together as a result of a dispatch error.

Injection of the sucrose and water commenced at 12:20 p.m. The buffered water stream was pumped by the Wheatley pump through the 10 micron filter pot and the UV Sterilizer. A 1 1/2" turbine meter, placed after the pump, was used to monitor the water rate. The water was line mixed with the mollases/sucrose solution pumped off the truck by the 2L4 Moyno and through a 25 micron filter pot. A Floco meter was used to calculate flowrates on the sucrose stream. Pressure drops were monitored across both filter pots. The 10 and 25 micron filters were rated to operate up to a ΔP of 50 psi and would plug at a ΔP of 80 psi. The first half tank of mollases/sucrose was emptied at 4:32 p.m. The pressure drop across the mollases filter pot had increased gradually to 40 psi during the 252 minutes of injection. The three 25 micron filters in the pot were changed out at this time. Line pressure downstream of the two filters held steady at 45-50 psi throughout. This downstream pressure was created by the 1" turbine meter on line to the wellhead. The wellhead pressure remained at 0 kPa. There was no pressure drop across the 10 micron filter on the water stream. Average injection rates during the 1st quarter were 34.8 L/min of mollases/sucrose and 210 L/min of water.

.../4

Injection resumed at 4:45 p.m. and we increased the mollases/sucrose flowrate. The second set of 25 micron filters on the mollases/sucrose stream were changed out at 6:30 pm. at a ΔP of 60 psi.

The first mollases/sucrose truck was emptied at 8:35 p.m. At this point we had injected 17.78m³ of mollases/sucrose and 100m³ of water based on the turbine meter totalizer, or 84m³ water based on tank gauges, over approximately 472 minutes of pumping time. Average injection rates were 212 L/min of water (or 178 L/min tank gauge), and 37.7 L/min of mollases/sucrose. I recalculated the approximate density of the mollases/sucrose solution based on a truck net weight of 22 030 kg and an injected volume of 17.78m³. The revised density was 1.24 kg/m³ to give a mollases/sucrose target rate of 42.6 L/min, based on a water flowrate of 200 L/min.

At 12:34 a.m. August 1, we shut down the mollases/sucrose stream to switch to the last half tank and changed out the 25 micron filters for the third time at a ΔP of 60 psi. The second mollases/sucrose truck was emptied at 4:24 a.m. and injection was complete. During this second half of injection we had injected 17.83m³ of mollases/sucrose, 91.5m³ of buffered water based on the turbine meter, or 82m³ of water based on tank gauges, over approximately 474 minutes of pumping time. Average injection rates were 193 L/min of water (or 173 L/min tank gauge), and 37.6 L/min of mollases.

Throughout the sucrose-water injection B8-2's wellhead pressure remained at 0 kPa. There was no pressure drop across the 10 micron water filter pot. The 25 micron mollases filters were changed out a total of 3 times.

Following the completion of injection, 7 drums (1.4m³) of bleach were loaded into a vacuum truck and injected down the wellhead at B8-2. The two offset producing wells A3-2 and A15-2 were shut-in immediatley following the completion of injection. They were sampled prior to shut-in and mollases was present in both samples. A3-2 and A15-2 had been placed on pump July 28 with the purpose of pumping during the injection phase.

Susan Payne

S. E. Payne

cc: R. G. Mills
C. A. Nygren
J. M. Campbell - Calgary
M. M. Kirzinger - Calgary
L. Stehmeier - Nova-Husky Research
Wellfile: B8-2-50-22 W3M

042/SEP

APPENDIX C

WATER ANALYSES FROM THE HUSKY ANALYTICAL SERVICES LABORATORY, LLOYDMINSTER

MEMORANDUM

TO: Les Stehmaier 1987 SEPTEMBER 21

FROM: R.D. Dillen REF. NO. P4-87

SUBJECT: **Standard Hill**

Twenty seven water samples were received in the laboratory. The Stiff Patterns and water analyses are attached.

R.D. Dillen

R.D. Dillen

RDD:AGR:adm

P4/082

Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME: Standard Hill
LOCATION: B1-2-50-22
FILE REFERENCE NUMBER: P4-87
ANALYST: Ann Rehman
DATE ANALYSED: YEAR 1987 MONTH 09 DAY 02
LAB SAMPLE NUMBER:
FORMATION: Waseca
FIELD:
DATE: YEAR 1987 MONTH 09 DAY 21
DATE SAMPLED: YEAR 1987 MONTH 08 DAY 19 (14:45)
SAMPLED BY:
SAMPLE CONTAINER(S): 1 litre plastic
PRESERVATIVE(S):

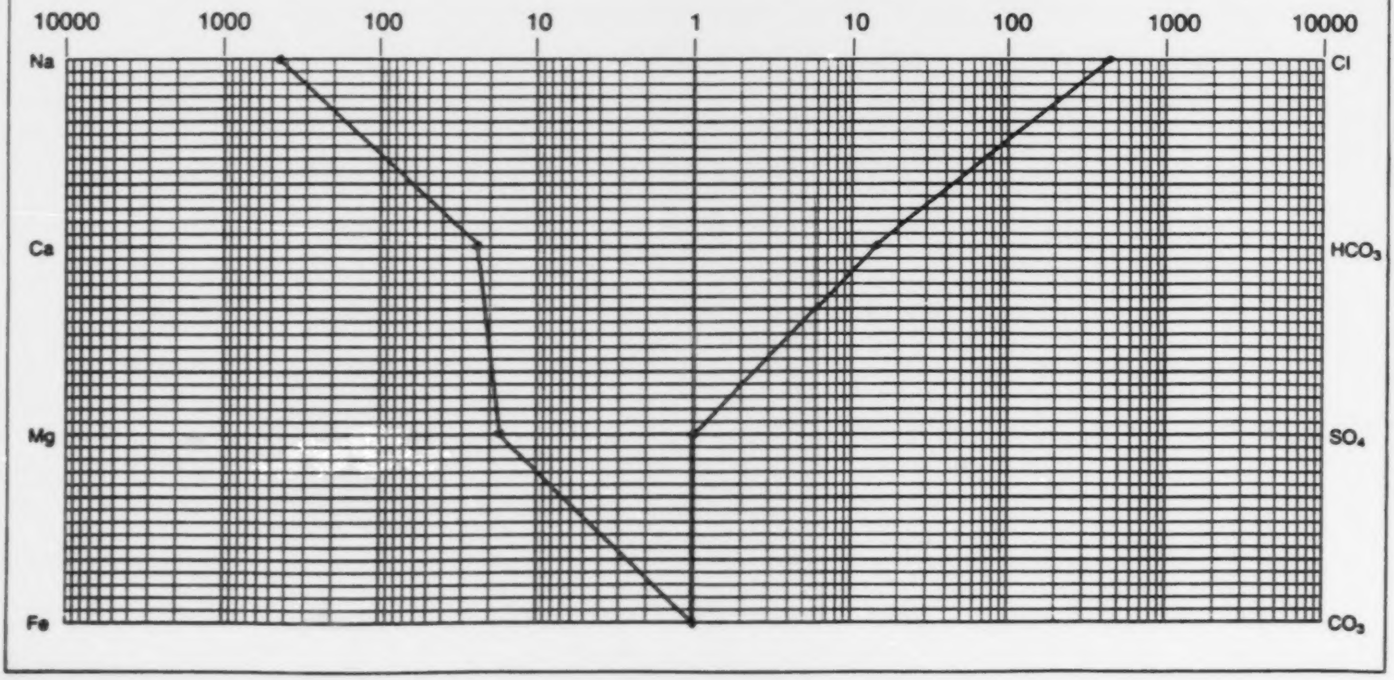
OBSERVED pH @ 22 °C: 7.07
DENSITY @ 15°C, g/ml:
RESISTIVITY @ 25°C, ohm - cm:
CONDUCTIVITY @ 25°C, µs/cm: 42 200
OIL AND GREASE, mg/L:
TOTAL HARDNESS, mg/L: 2 080 (calc)
TOTAL DISSOLVED SOLIDS, mg/L: 27 350 (calc)
TOTAL SUSPENDED SOLIDS, mg/L:
VOLATILE SUSPENDED SOLIDS, mg/L:
FIXED SUSPENDED SOLIDS, mg/L:

Surface Tension 72.8

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 160	442
Ca	502	25
Mg	201	17
Fe	3.84	0
K	253	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	15 324	432
HCO_3	892	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	11	0

LOGARITHMIC WATER PATTERN (meg/L)



0343 - 8509

Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME: Standard Hill
LOCATION: B1-2-50-22
FILE REFERENCE NUMBER: P4-87
ANALYST: Ann Rehman
DATE ANALYSED: YEAR 1987 MONTH 09 DAY 16
LAB SAMPLE NUMBER:
FORMATION: Waseca
FIELD:
DATE: YEAR 1987 MONTH 09 DAY 21
DATE SAMPLED: YEAR 1987 MONTH 08 DAY 20 (10:20)
SAMPLED BY:
SAMPLE CONTAINER(S): 1 litre plastic
PRESERVATIVE(S):

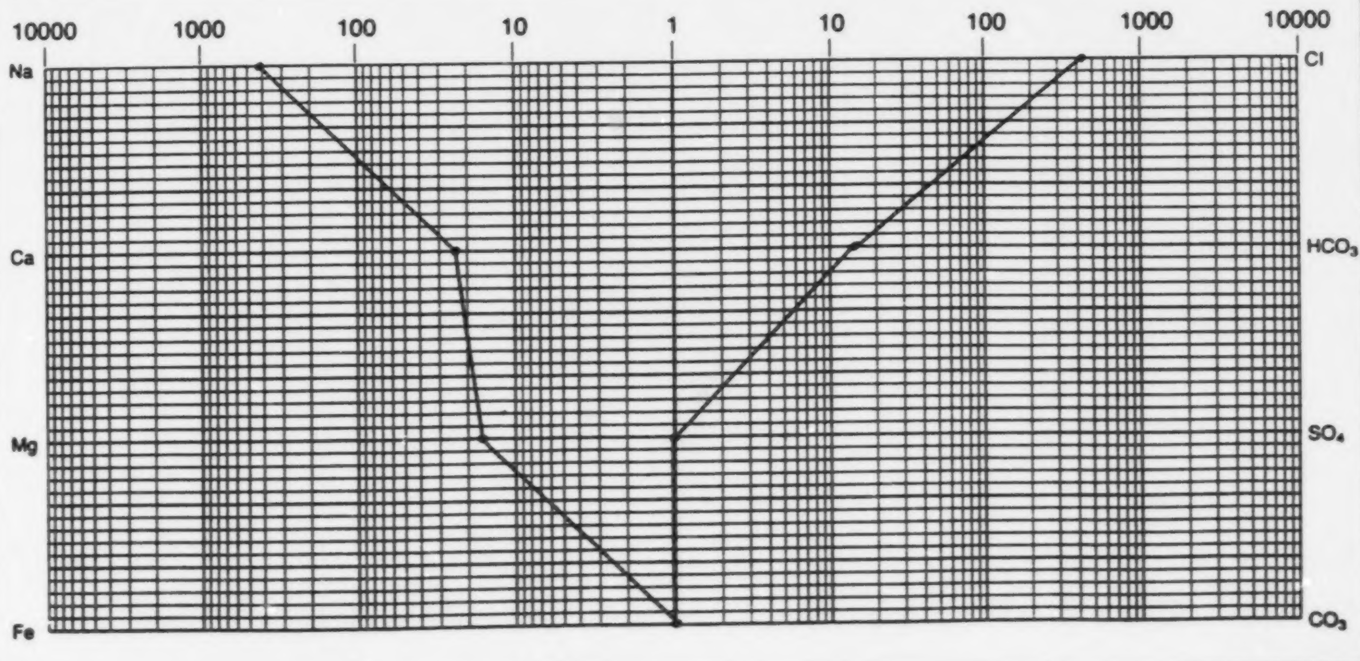
OBSERVED pH @ 22 °C: 6.93
DENSITY @ 15°C, g/ml:
RESISTIVITY @ 25°C, ohm - cm:
CONDUCTIVITY @ 25°C, µs/cm: 42 900
OIL AND GREASE, mg/L:
TOTAL HARDNESS, mg/L: 2 010 (calc)
TOTAL DISSOLVED SOLIDS, mg/L: 26 930 (calc)
TOTAL SUSPENDED SOLIDS, mg/L:
VOLATILE SUSPENDED SOLIDS, mg/L:
FIXED SUSPENDED SOLIDS, mg/L:

Surface Tension 69.1

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Na	9 720	423
Ca	486	24
Mg	193	16
Fe	2.87	0
K	238	6
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Cl	15 380	434
HCO_3	897	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	12	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill		LOCATION B1-2-50-22	FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR MONTH DAY 1987 09 16	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED YEAR MONTH DAY 1987 08 21 (10:20)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 7.07

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, μs/cm 41 900

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 1 930 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 29 920 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

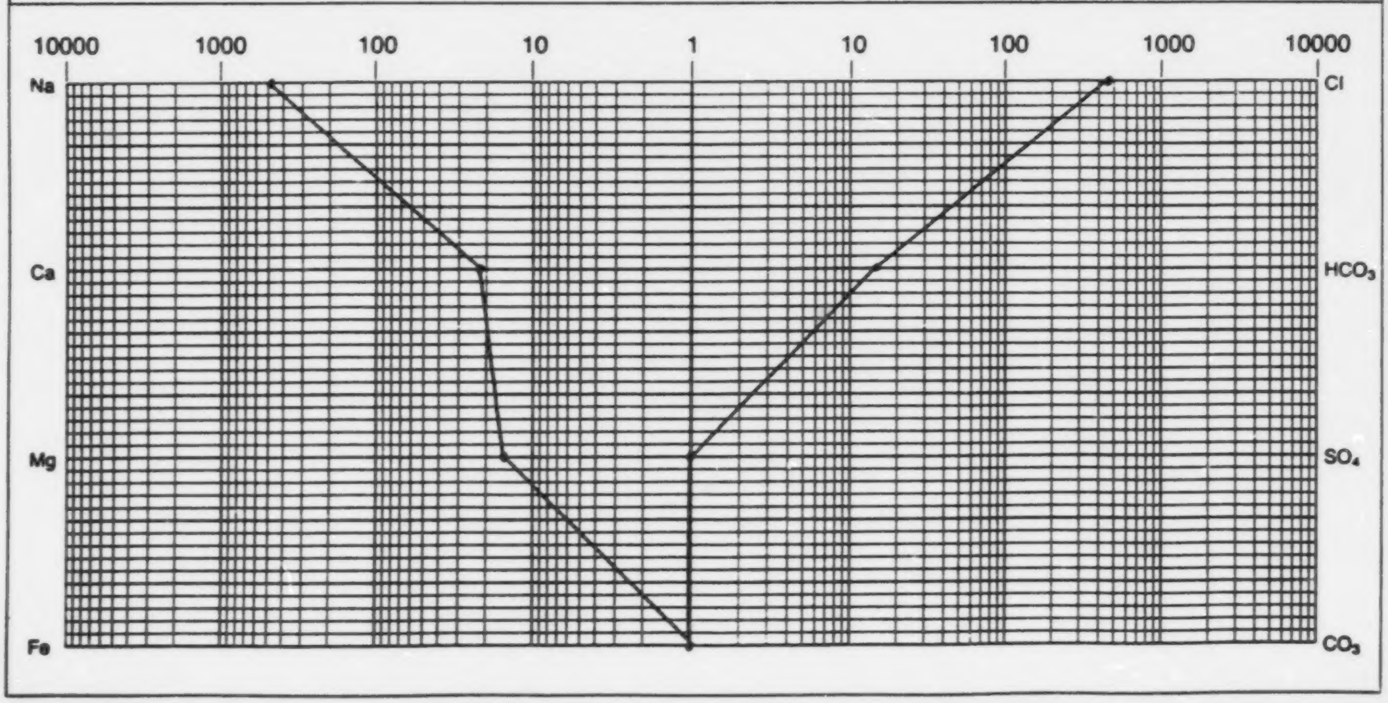
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 59.8

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Na	11 270	490
Ca	459	23
Mg	191	16
Fe	2.26	0
K	281	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Cl	16 822	474
HCO_3	892	15
SO_4	1	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky

HEAVY OIL LABORATORY WATER ANALYSIS

X

WELL NAME Standard Hill	LOCATION B2-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR MONTH DAY 1987 09 02	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED YEAR MONTH DAY 1987 08 19 (14:45)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

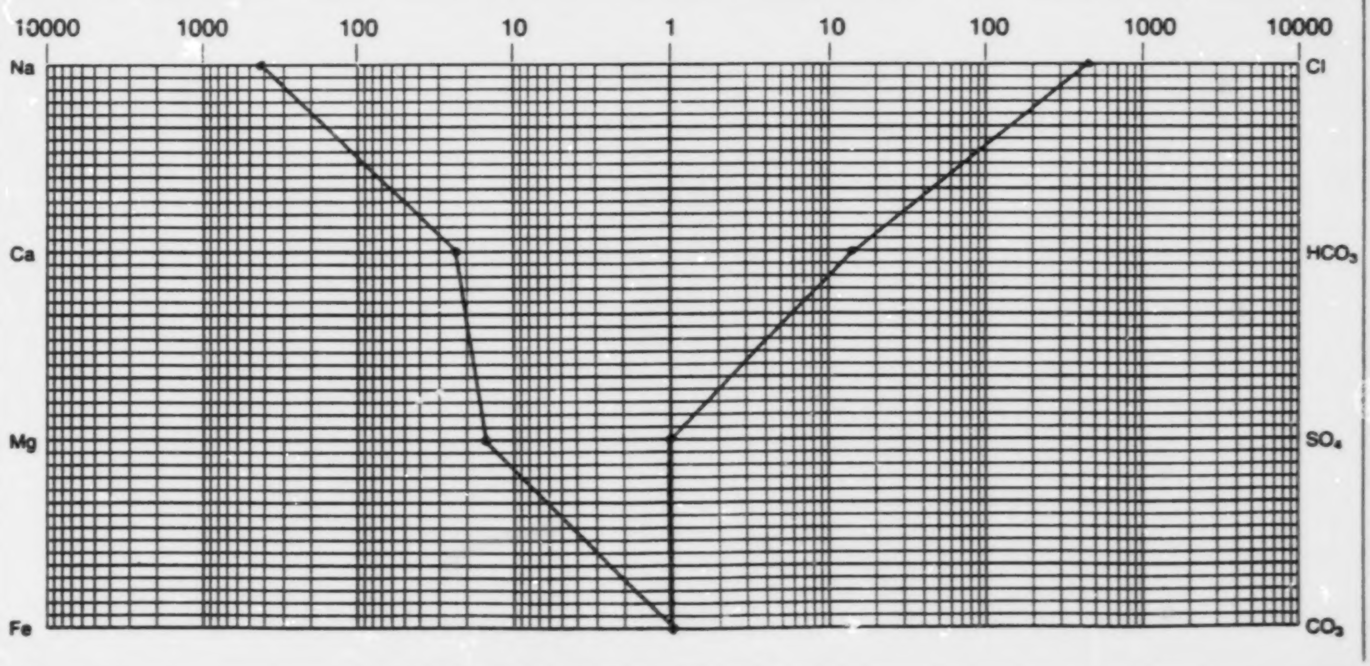
OBSERVED pH @ 22 °C	6.99	TOTAL HARDNESS, mg/L	1 980 (calc)
DENSITY @ 15°C, g/ml		TOTAL DISSOLVED SOLIDS, mg/L	28 460 (calc)
RESISTIVITY @ 25°C, ohm - cm		TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, µs/cm	43 300	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension 67.4

ION	CONCENTRATION	
	mg/L	meq/L
Na	9 980	434
Ca	475	24
Mg	194	16
Fe	13.08	1
K	261	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	16 621	469
HCO_3	907	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	10	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



0343 - 8509

Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION B2-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR 1987 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR 1987 MONTH 09 DAY 21
DATE SAMPLED YEAR 1987 MONTH 08 DAY 20 (09:10)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 6.84

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, μs/cm 43 900

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2 180 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 30 800 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

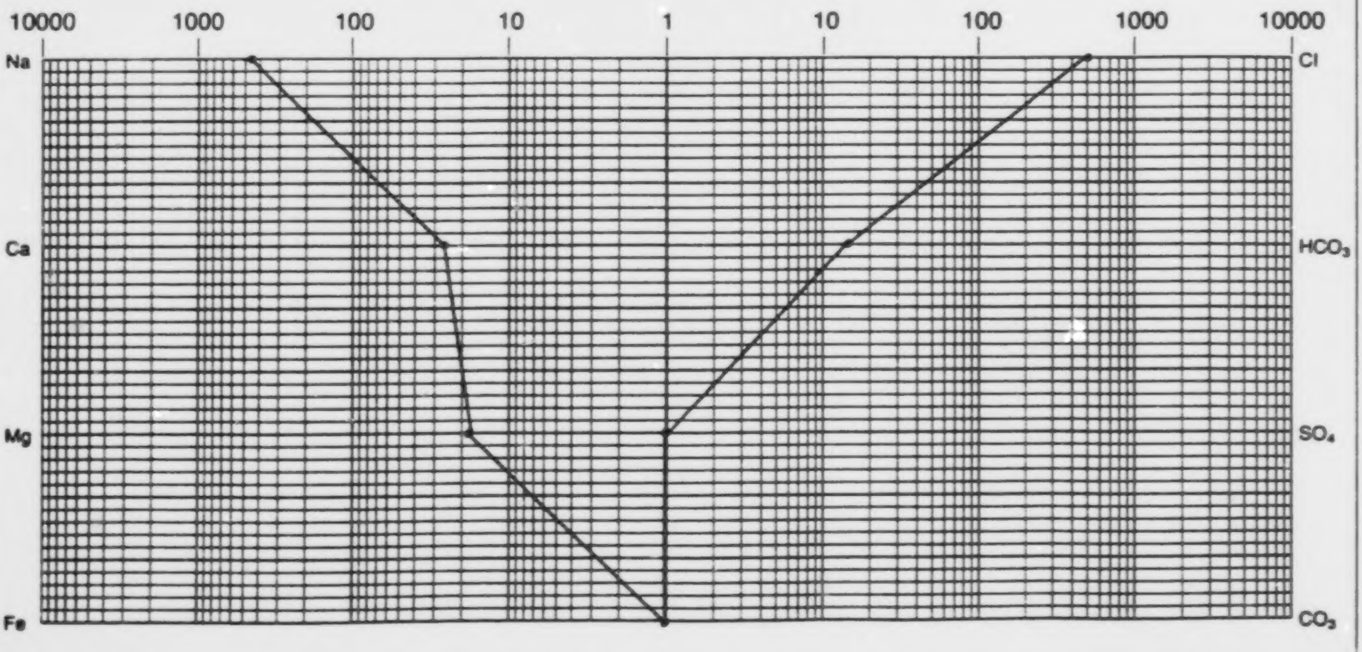
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 67.6

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 950	476
Ca	520	26
Mg	214	18
Fe	10.12	1
K	244	6
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	17 947	506
HCO_3	907	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	4	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION B2-2-50-22	FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman	DATE ANALYSED YEAR MONTH DAY 1987 09 02	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD	DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED 1987 08 21 (09:00)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic
		PRESERVATIVE(S)

OBSERVED pH @ 22 °C 7.06

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, μs/cm 42 400

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 1 820 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 29 140 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

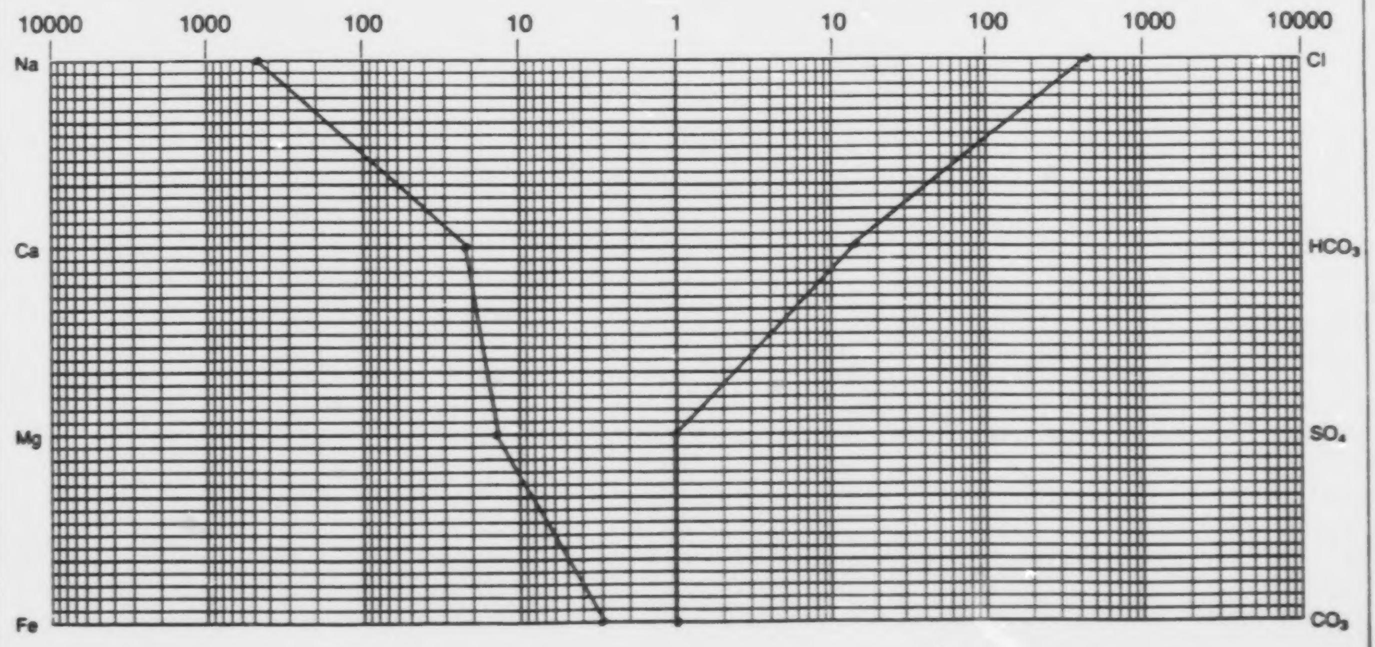
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 70.0

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 800	470
Ca	440	22
Mg	176	15
Fe	50	3
K	243	6
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	16 521	466
HCO_3	912	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meg/L)



0343 - 8508

Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION B3-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR MONTH DAY 1987 09 16	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED YEAR MONTH DAY 1987 08 19 (14:20)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

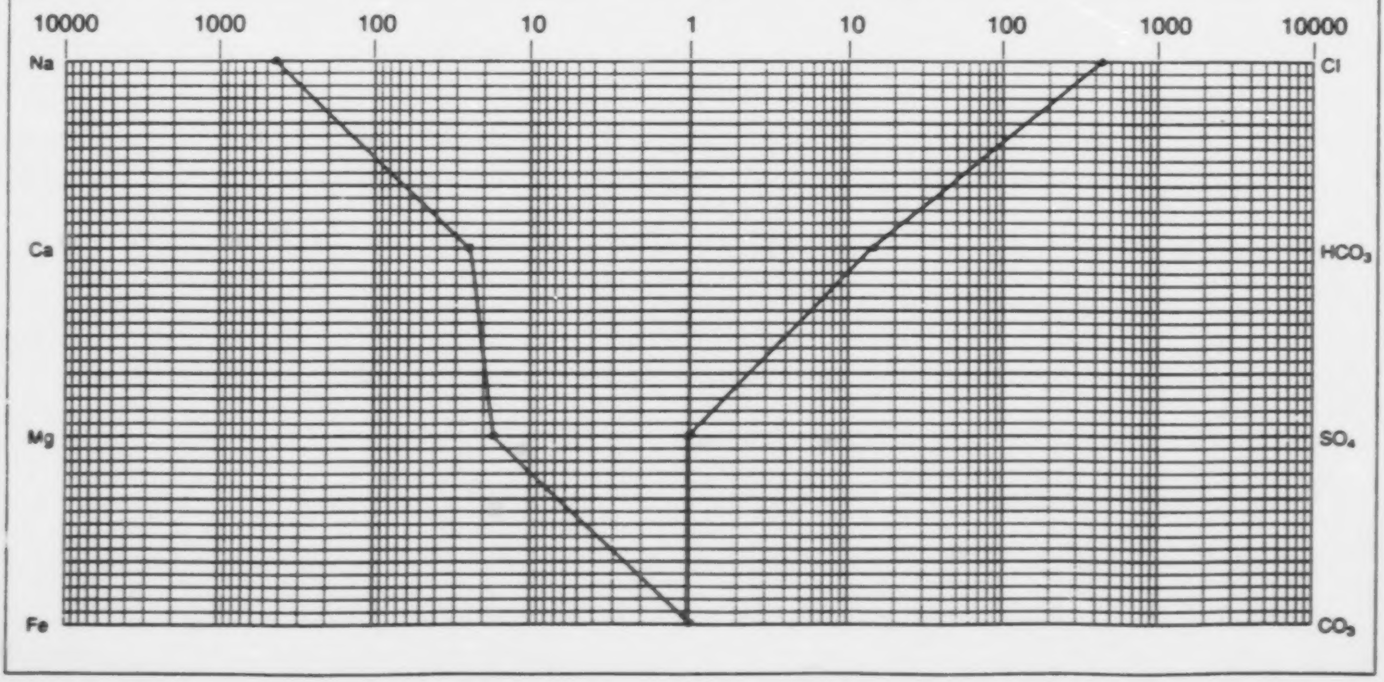
OBSERVED pH @ 22 °C	6.88	TOTAL HARDNESS, mg/L	2 110 (calc)
DENSITY @ 15°C, g/ml		TOTAL DISSOLVED SOLIDS, mg/L	27 910 (calc)
RESISTIVITY @ 25°C, ohm - cm		TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, µs/cm	42 300	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension 66.0

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 630	462
Ca	505	25
Mg	207	17
Fe	4.34	0
K	284	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	15 386	434
HCO_3	892	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



0343 - 8509

Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION B3-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR 1987 MONTH 09 DAY 02	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR 1987 MONTH 09 DAY 21
DATE SAMPLED YEAR 1987 MONTH 08 DAY 20 (09:00)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 6.90

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, μs/cm 43 800

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 1 780 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 29 040 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

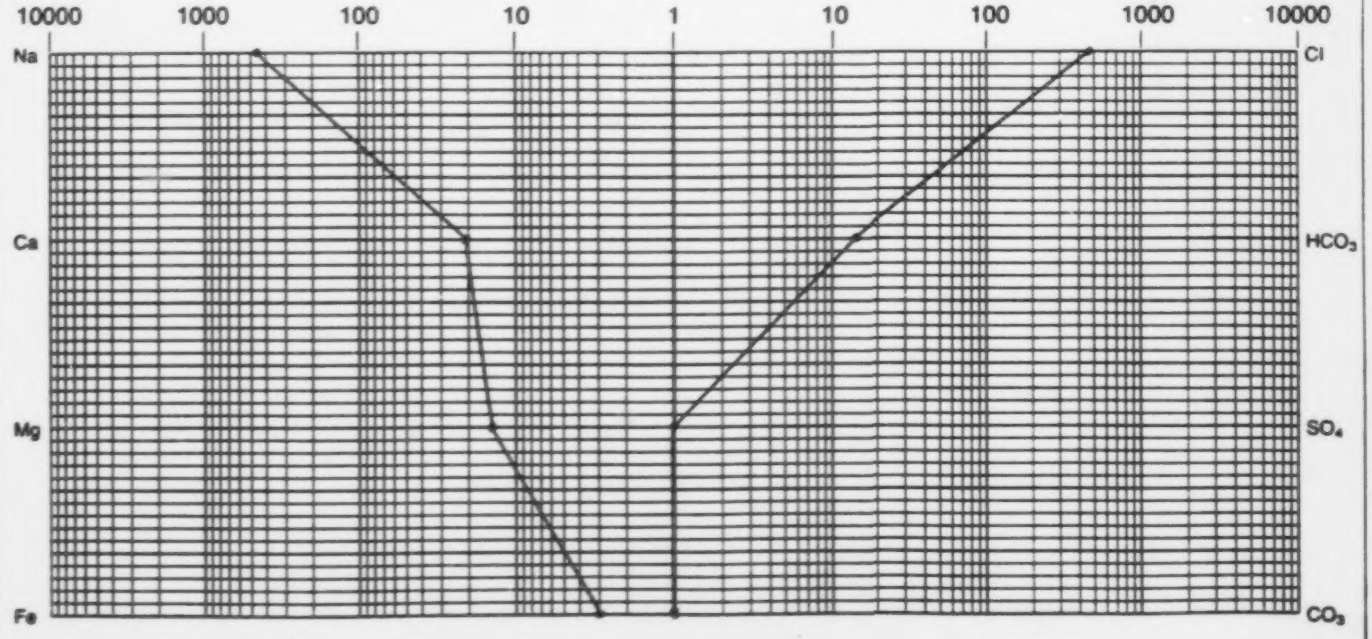
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 69.7

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 620	462
Ca	423	21
Mg	177	15
Fe	49	3
K	251	6
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	16 604	468
HCO_3	907	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	10	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION B3-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR MONTH DAY 1987 09 16	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED YEAR MONTH DAY 1987 08 21 (09:35)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 6.83
DENSITY @ 15°C, g/ml
RESISTIVITY @ 25°C, ohm - cm
CONDUCTIVITY @ 25°C, µs/cm 43 100
OIL AND GREASE, mg/L

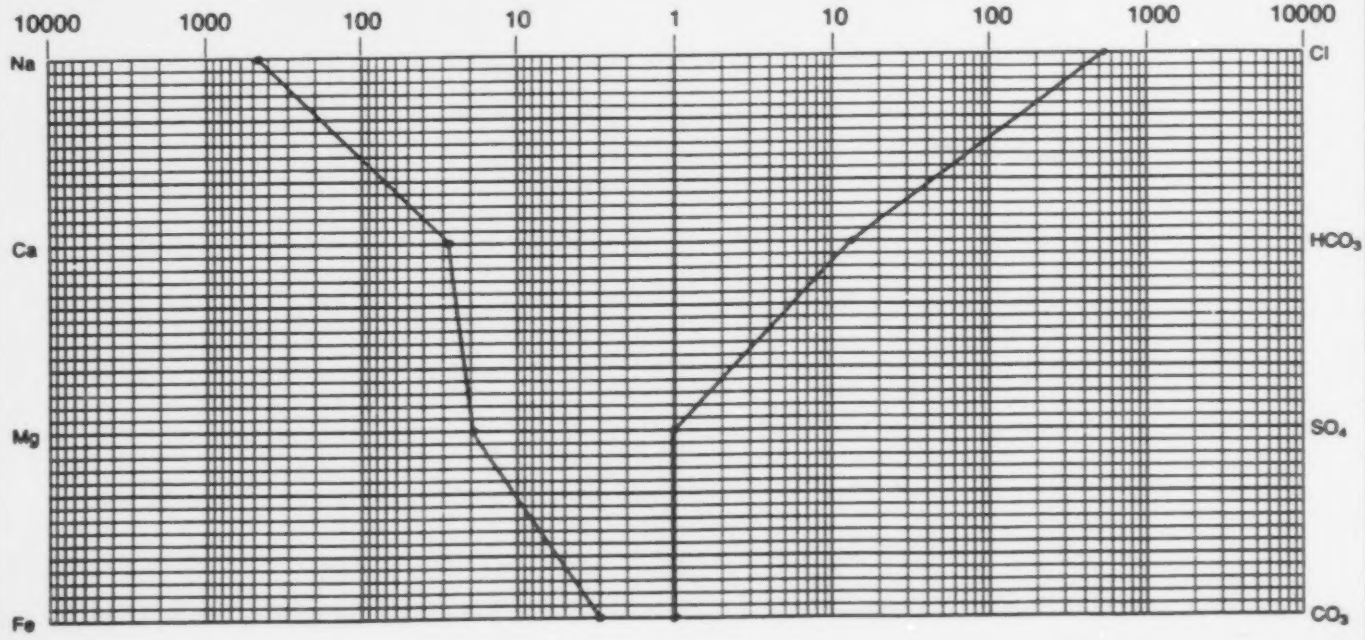
TOTAL HARDNESS, mg/L 2 230 (calc)
TOTAL DISSOLVED SOLIDS, mg/L 31 730 (calc)
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 63.0

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 150	485
Ca	538	27
Mg	215	18
Fe	51	3
K	254	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	18 670	527
HCO_3	853	14
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



0343 - 8509

Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION B6-2-50-22	FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman	DATE ANALYSED YEAR MONTH DAY 1987 09 16	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD	DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED YEAR MONTH DAY 1987 08 19 (14:10)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic
		PRESERVATIVE(S)

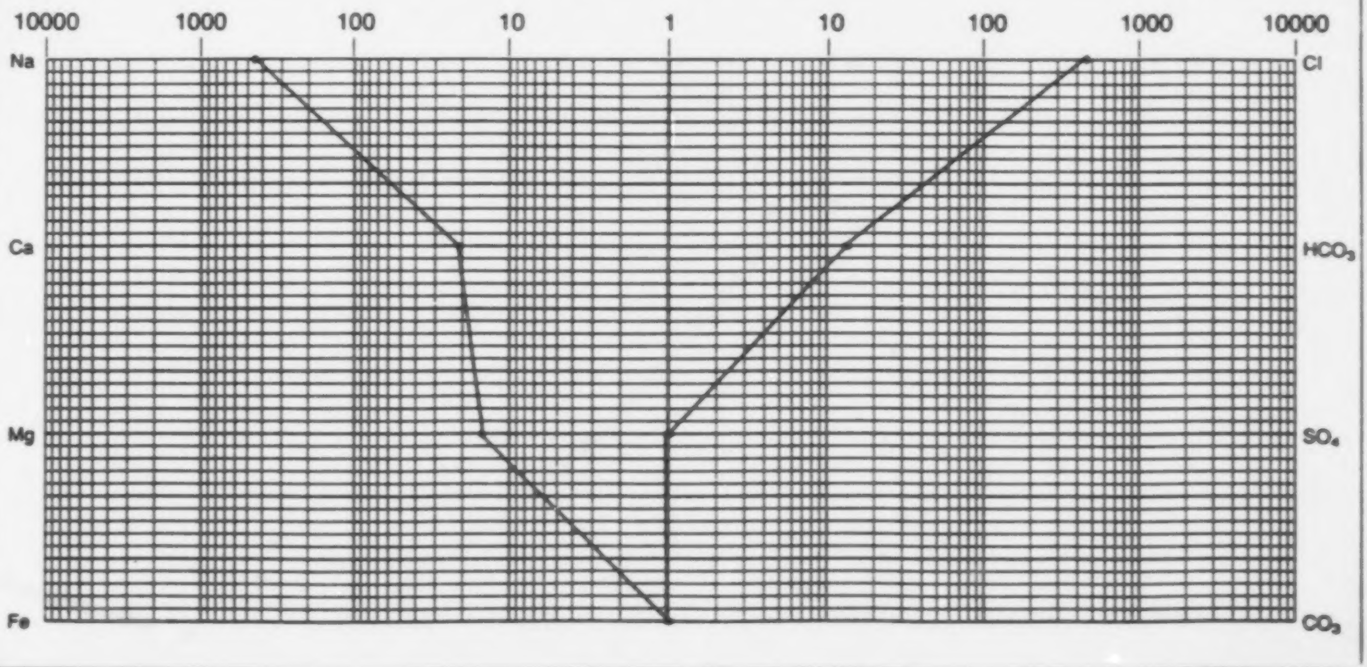
OBSERVED pH @ 22 °C 7.37
DENSITY @ 15°C, g/ml
RESISTIVITY @ 25°C, ohm - cm
CONDUCTIVITY @ 25°C, μs/cm 43 100
OIL AND GREASE, mg/L
TOTAL HARDNESS, mg/L 1 840 (calc)
TOTAL DISSOLVED SOLIDS, mg/L 28 550 (calc)
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 73.6

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 340	450
Ca	427	21
Mg	189	16
Fe	5.22	0
K	253	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	16 469	464
HCO_3	868	14
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



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Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION B6-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR 1987 MONTH 09 DAY 02	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR 1987 MONTH 09 DAY 21
DATE SAMPLED YEAR 1987 MONTH 08 DAY 20 (08:50)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 7.21

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, µs/cm 43 800

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 1 660 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 28 620 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

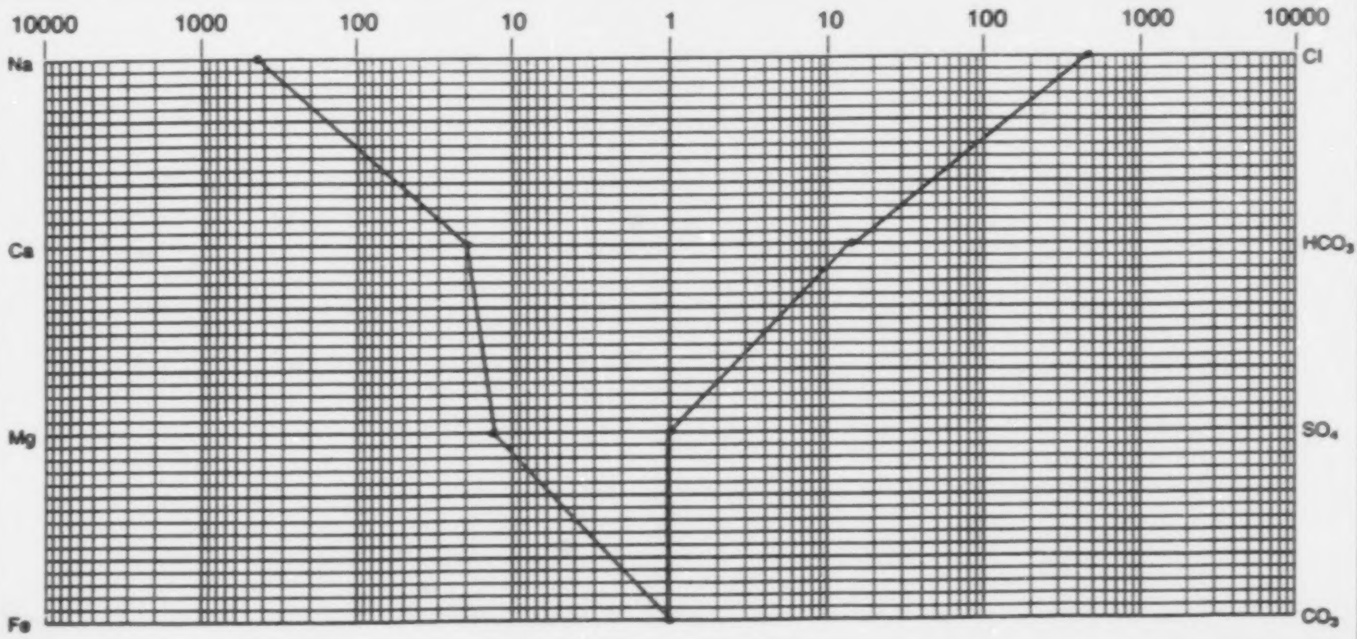
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 73.7

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 220	445
Ca	382	19
Mg	173	14
Fe	3	0
K	275	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	16 639	469
HCO_3	922	15
SO_4	1	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION B6-2-50-22	FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman	DATE ANALYSED YEAR MONTH DAY 1987 | 09 | 16	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD	DATE YEAR MONTH DAY 1987 | 09 | 21
DATE SAMPLED 1987 | 08 | 21 (09:40)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic
		PRESERVATIVE(S)

OBSERVED pH @ 22 °C 6.84

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, μs/cm 44 300

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 1 800 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 29 650 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

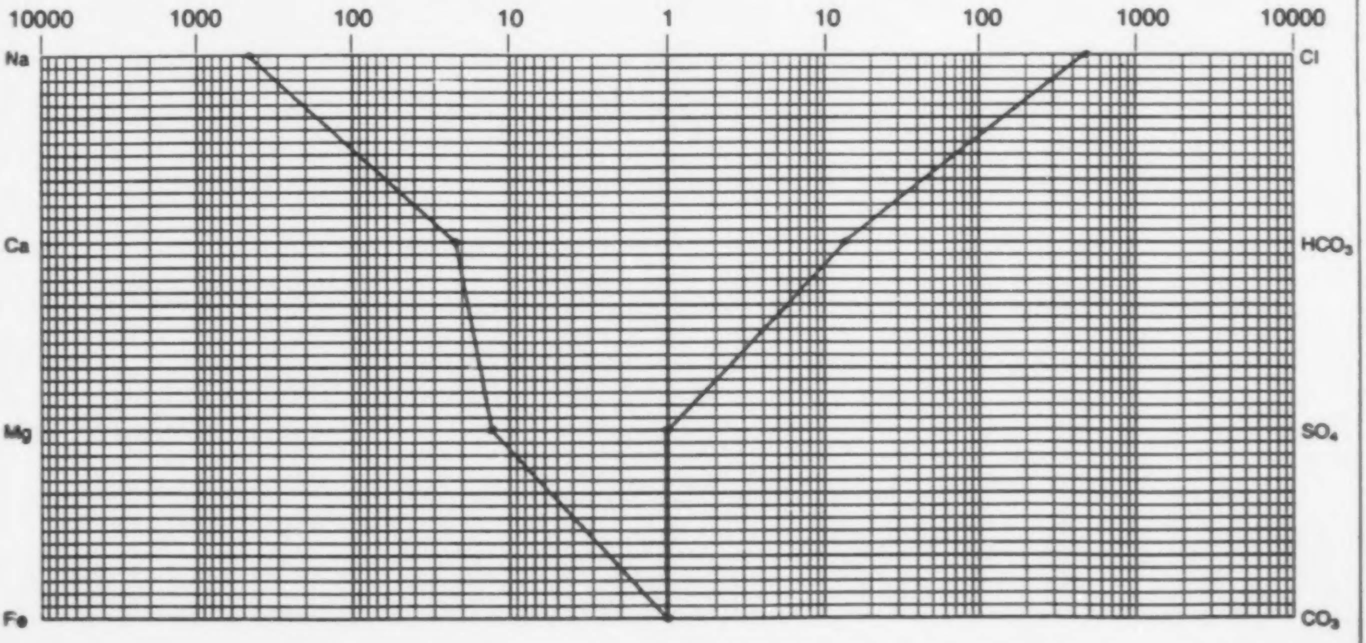
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 64.4

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Na	10 650	463
Ca	433	22
Mg	175	14
Fe	3.74	0
K	268	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Cl	17 235	486
HCO_3	877	14
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	10	0

LOGARITHMIC WATER PATTERN (meq/L)



0343 - 8509

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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A7-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR MONTH DAY 1987 09 02	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED YEAR MONTH DAY 1987 08 19 (14:35)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 7.03
DENSITY @ 15°C, g/ml
RESISTIVITY @ 25°C, ohm - cm
CONDUCTIVITY @ 25°C, µs/cm 42 800
OIL AND GREASE, mg/L

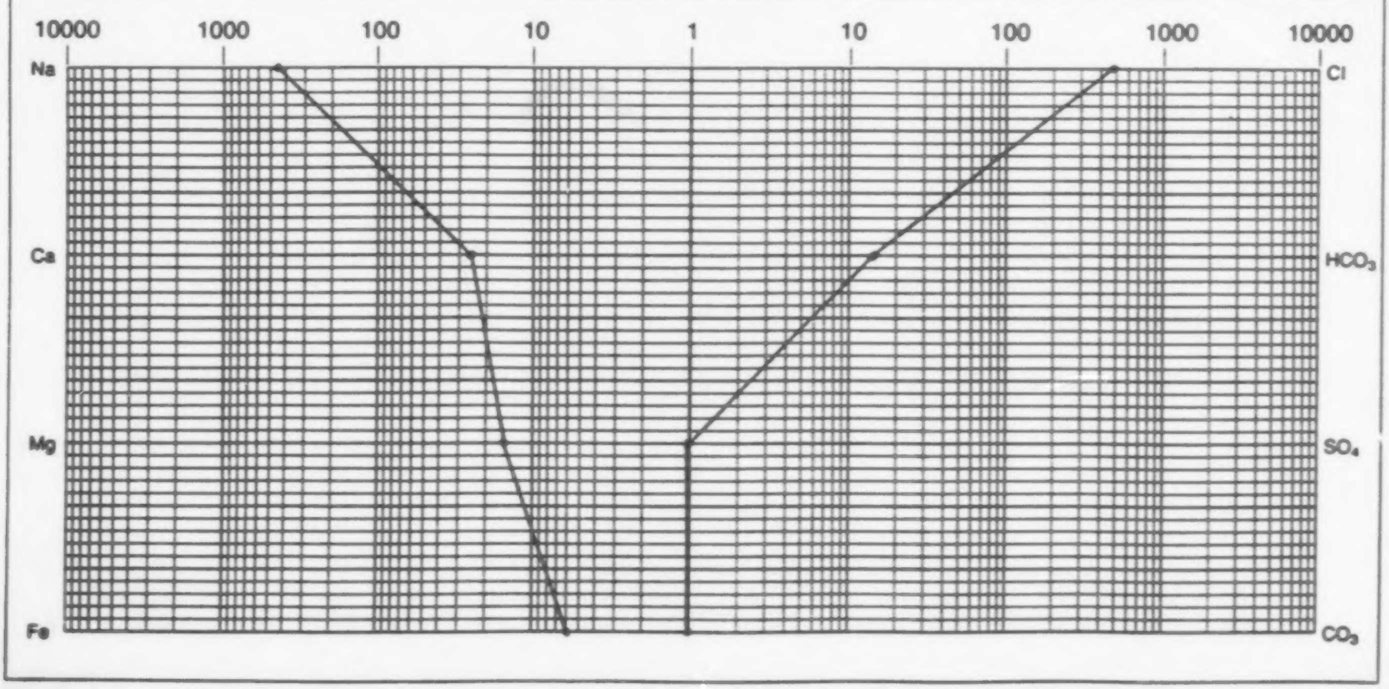
TOTAL HARDNESS, mg/L 2 090 (calc)
TOTAL DISSOLVED SOLIDS, mg/L 30 230 (calc)
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 61.0

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 670	464
Ca	512	26
Mg	197	16
Fe	113	6
K	246	6
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	17 552	495
HCO_3	936	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A7-2-50-22	FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman	DATE ANALYSED YEAR MONTH DAY 1987 09 02	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD	DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED YEAR MONTH DAY 1987 08 20 (09:30)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic
		PRESERVATIVE(S)

OBSERVED pH @ 22 °C 6.93

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, μs/cm 42 600

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 1 790 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 27 430 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

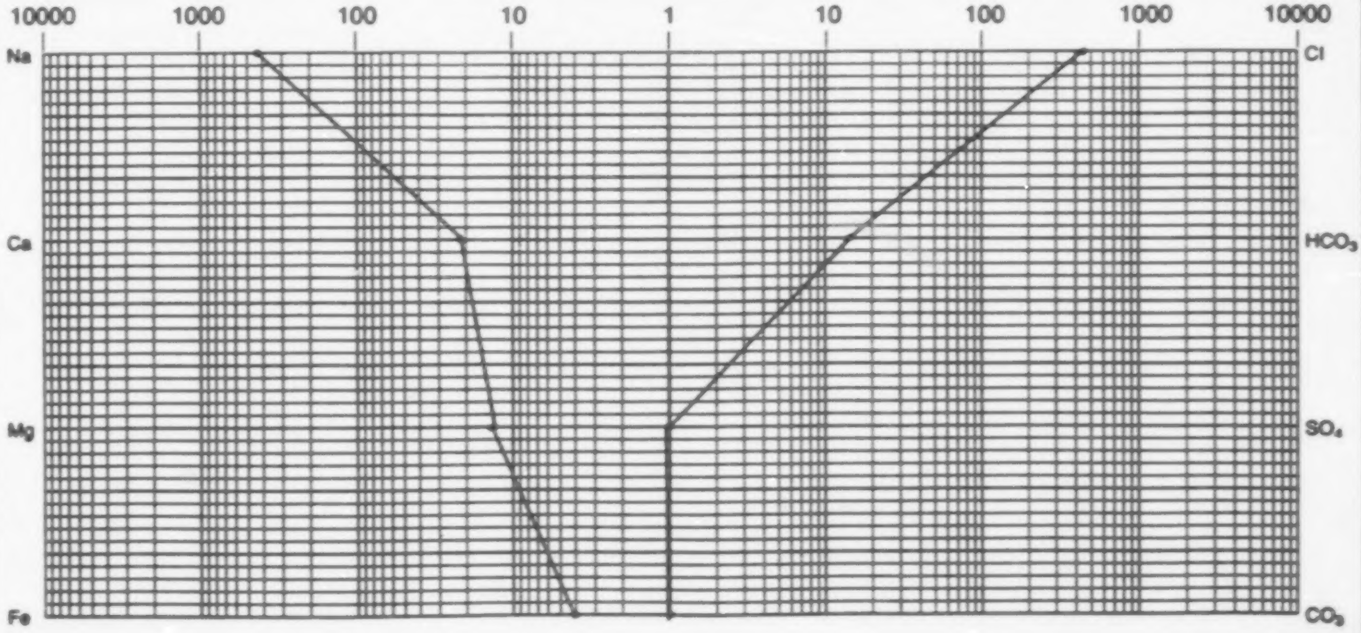
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 62.7

ION	CONCENTRATION	
	mg/L	meq/L
Na	9 700	422
Ca	433	22
Mg	173	14
Fe	72	4
K	248	6
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	15 898	448
HCO_3	907	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



0043 - 8800

Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A7-2-50-22	FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman	DATE ANALYSED YEAR MONTH DAY 1987 09 16	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD	DATE YEAR MONTH DAY 1987 09 21

DATE SAMPLED YEAR MONTH DAY 1987 08 21 (09:10)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 6.96

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, µs/cm 41 900

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 1 760 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 29 770 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

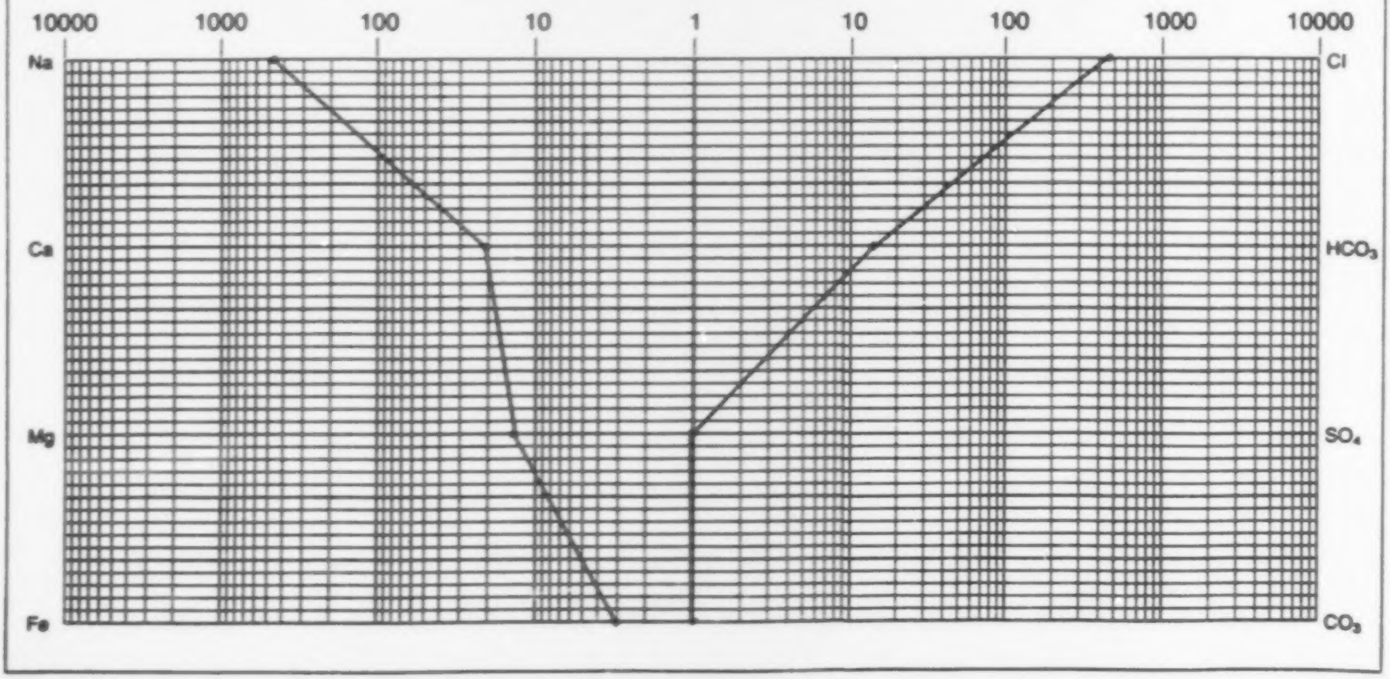
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 65.8

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Na	11 150	485
Ca	422	21
Mg	172	14
Fe	63	3
K	250	6
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Cl	16 821	474
HCO_3	892	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



0343 - 8808

Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION B8-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR MONTH DAY 1987 09 02	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED YEAR MONTH DAY 1987 08 19 (14:40)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 7.08

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm · cm

CONDUCTIVITY @ 25°C, µs/cm 42 100

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 1 840 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 27 820 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

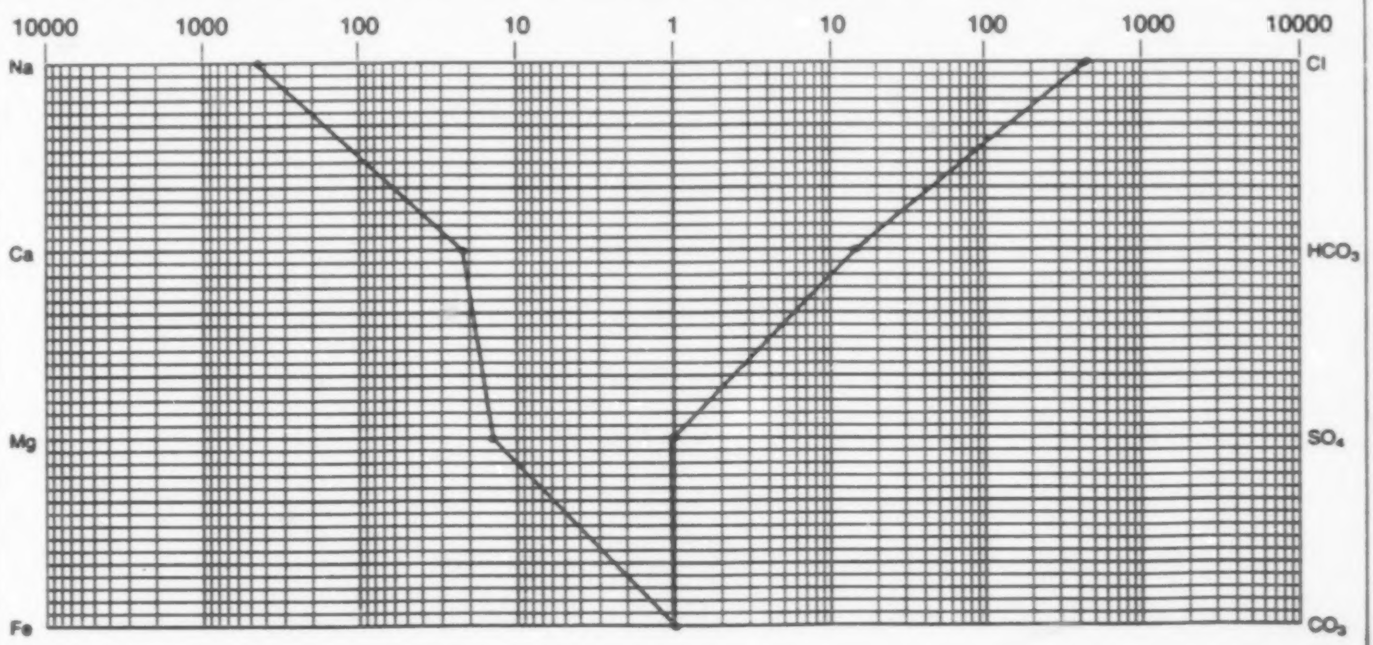
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 65.0

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 300	448
Ca	447	22
Mg	177	15
Fe	8.66	1
K	258	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	15 741	444
HCO_3	892	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION B8-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR MONTH DAY 1987 09 16	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED YEAR MONTH DAY 1987 08 20 (09:30)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 6.96

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, μs/cm 42 400

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 1 980 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 27 870 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

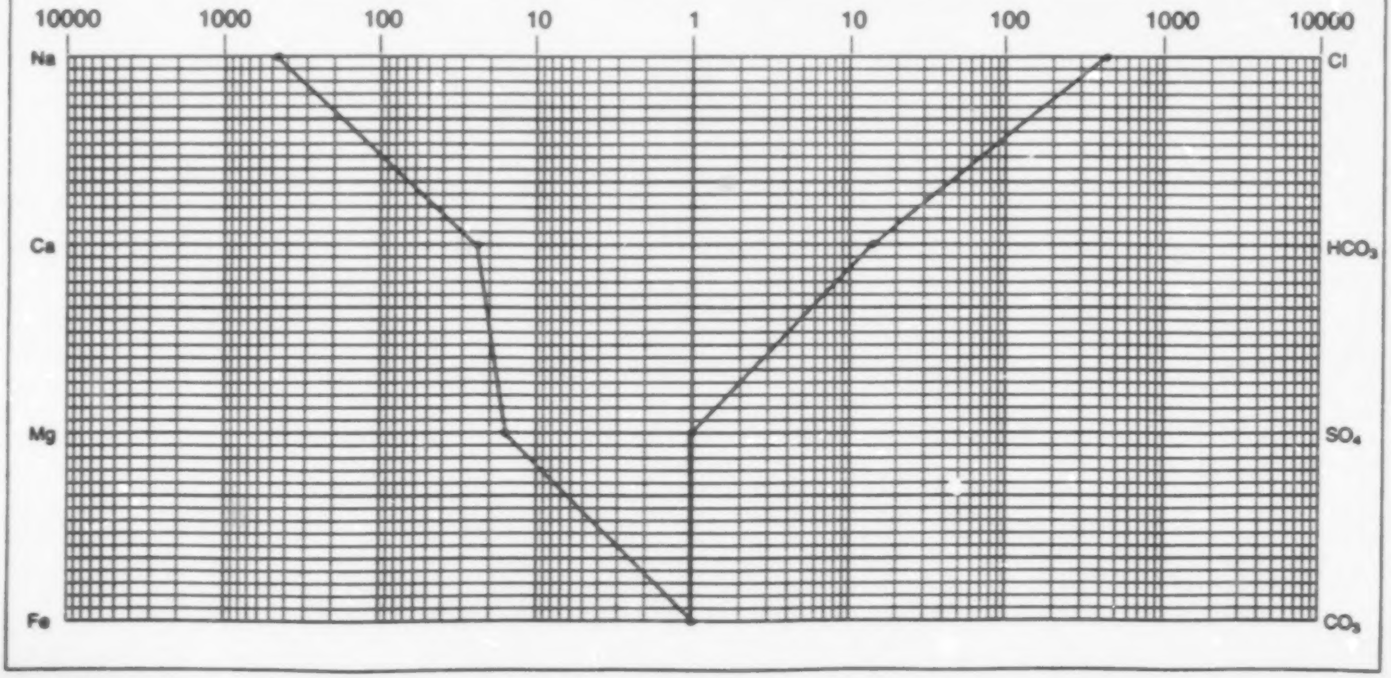
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 64.1

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 580	460
Ca	472	24
Mg	196	16
Fe	7.48	0
K	278	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	15 431	435
HCO_3	892	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	11	0

LOGARITHMIC WATER PATTERN (meq/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION B8-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR MONTH DAY 1987 09 02	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED YEAR MONTH DAY 1987 08 21 (09:25)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 7.23

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, µs/cm 41 400

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 1 940 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 30 870 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

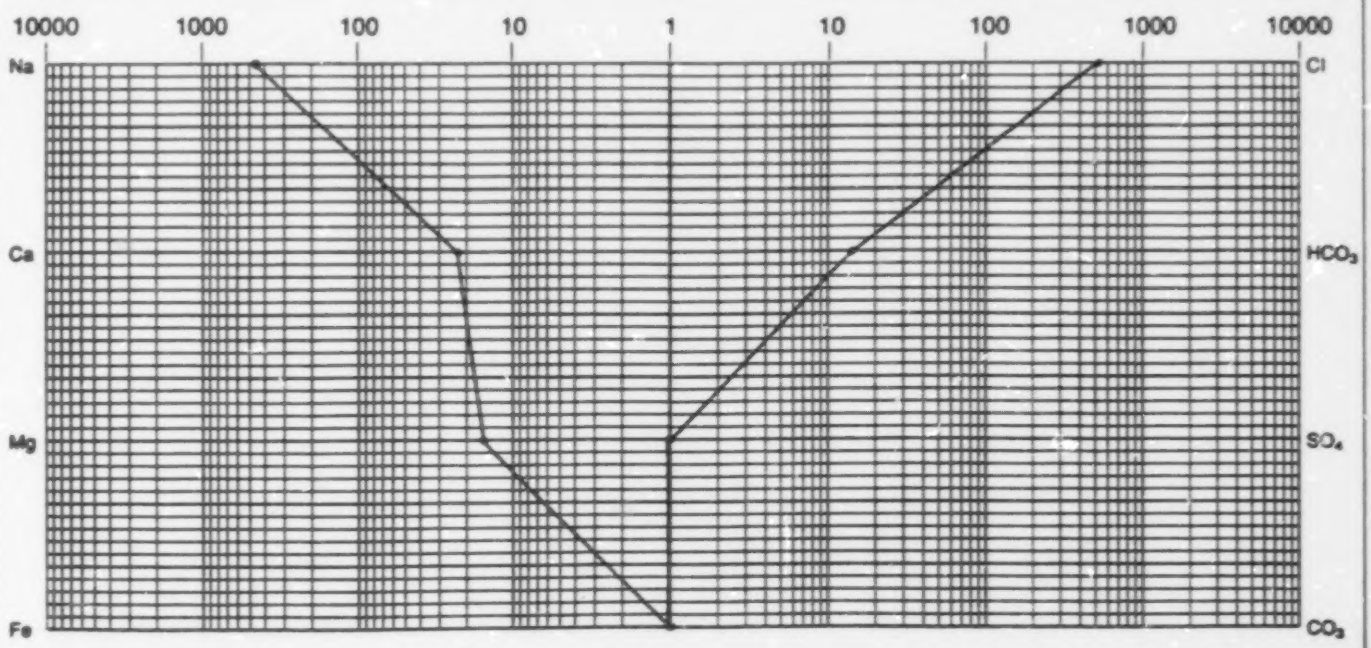
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 61.0

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 530	460
Ca	464	23
Mg	189	16
Fe	7.24	0
K	285	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	18 450	520
HCO_3	887	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	10	0

LOGARITHMIC WATER PATTERN (meq/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A10-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR, MONTH, DAY 1987, 09, 02	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR, MONTH, DAY 1987, 09, 21
DATE SAMPLED YEAR, MONTH, DAY 1987, 08, 19 (14:30)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 7.34

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, μs/cm 42 900

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2 150 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 30 060 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

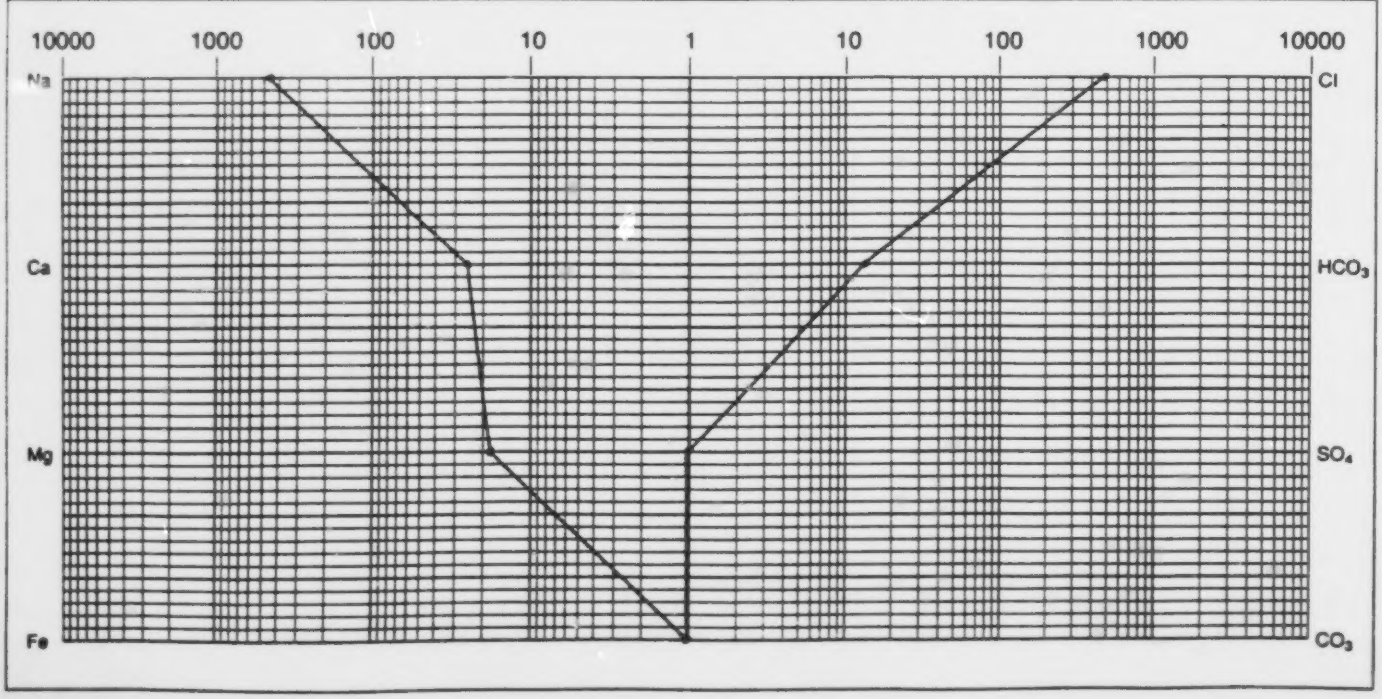
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 68.5

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Na	10 610	462
Ca	500	25
Mg	220	18
Fe	1.26	0
K	297	8
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Cl	17 553	495
HCO_3	878	14
SO_4	1	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



0043 - 0008

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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A10-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR MONTH DAY 1987 09 16	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED YEAR MONTH DAY 1987 08 20 (09:40)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 7.11

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, μs/cm 43 500

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2 090 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 28 500 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

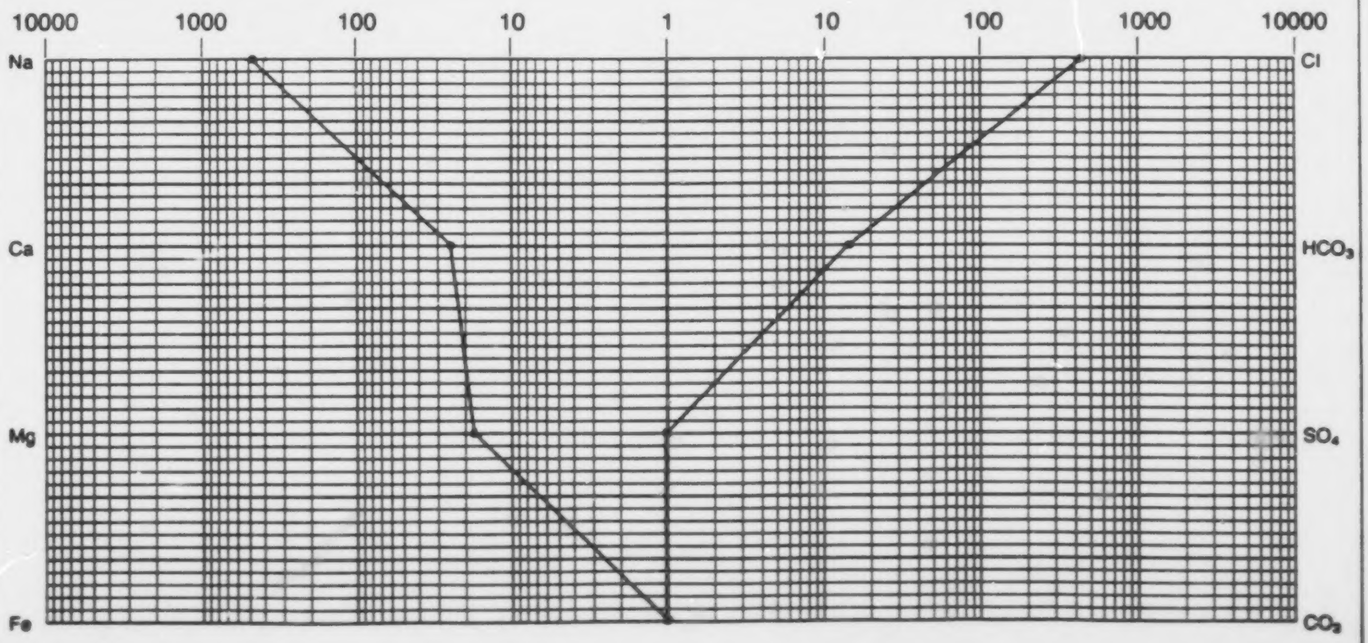
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 72.0

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 030	480
Ca	495	25
Mg	209	17
Fe	0.42	0
K	257	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	15 611	440
HCO_3	897	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A10-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR MONTH DAY 1987 09 16	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED YEAR MONTH DAY 1987 08 21 (09:05)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 6.85

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, μs/cm 42 000

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2 070 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 27 580 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

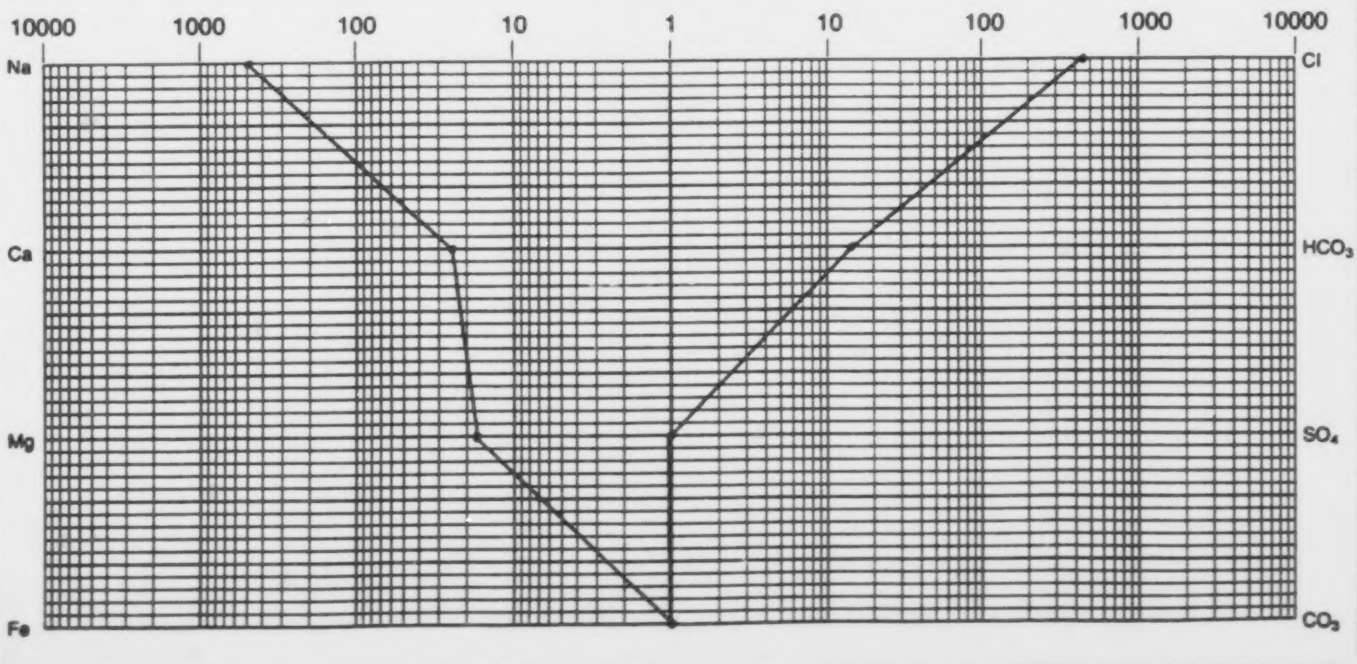
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 63.2

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 330	493
Ca	498	25
Mg	202	17
Fe	17.29	1
K	284	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	16 333	461
HCO_3	912	15
SO_4	2	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A15-2-50-22	FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman	DATE ANALYSED YEAR 1987 MONTH 09 DAY 02	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD	DATE YEAR 1987 MONTH 09 DAY 21
DATE SAMPLED YEAR 1987 MONTH 08 DAY 19 (13:50)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic
		PRESERVATIVE(S)

OBSERVED pH @ 22 °C 7.13

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, μs/cm 42 500

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 1 970 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 28 900 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

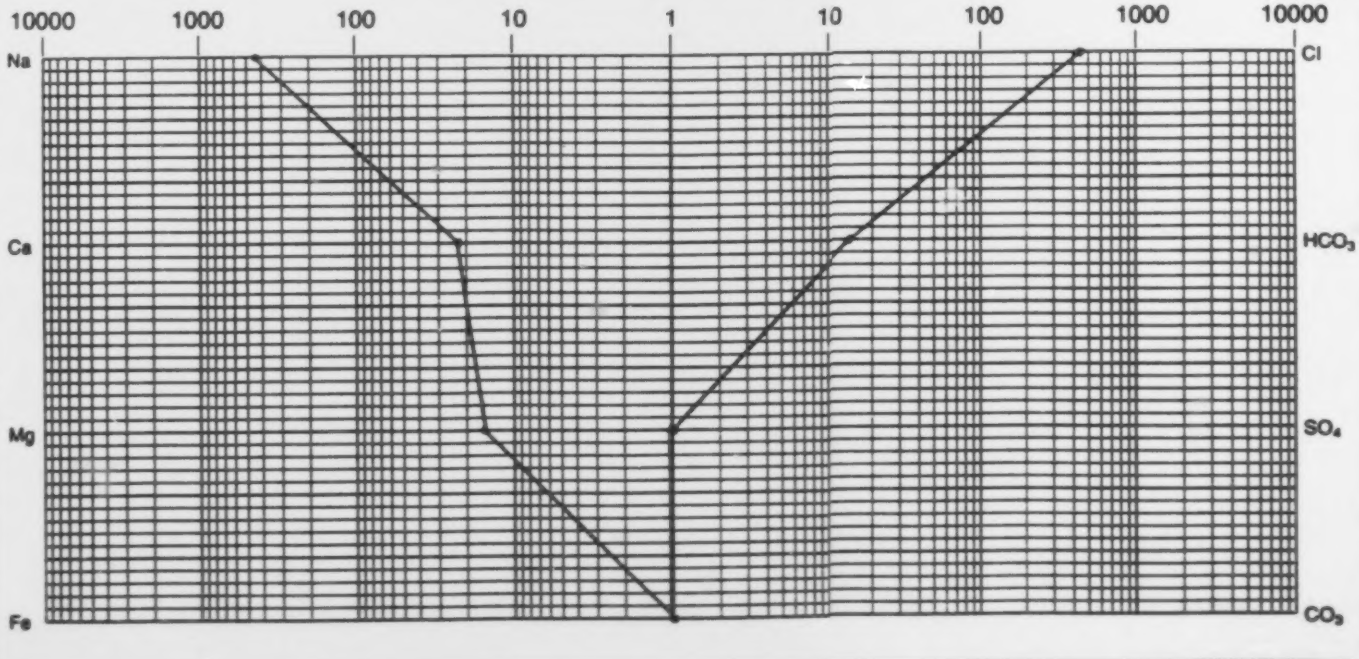
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 67.6

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 700	466
Ca	464	23
Mg	197	16
Fe	7.65	0
K	244	6
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	16 399	463
HCO_3	887	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME: Standard Hill
LOCATION: A15-2-50-22
FILE REFERENCE NUMBER: P4-87
ANALYST: Ann Rehman
DATE ANALYSED: YEAR 1987 MONTH 09 DAY 02
LAB SAMPLE NUMBER:
FORMATION: Waseca
FIELD:
DATE: 1987 MONTH 09 DAY 21
DATE SAMPLED: 1987 MONTH 08 DAY 20 (08:30)
SAMPLED BY:
SAMPLE CONTAINER(S): 1 litre plastic
PRESERVATIVE(S):

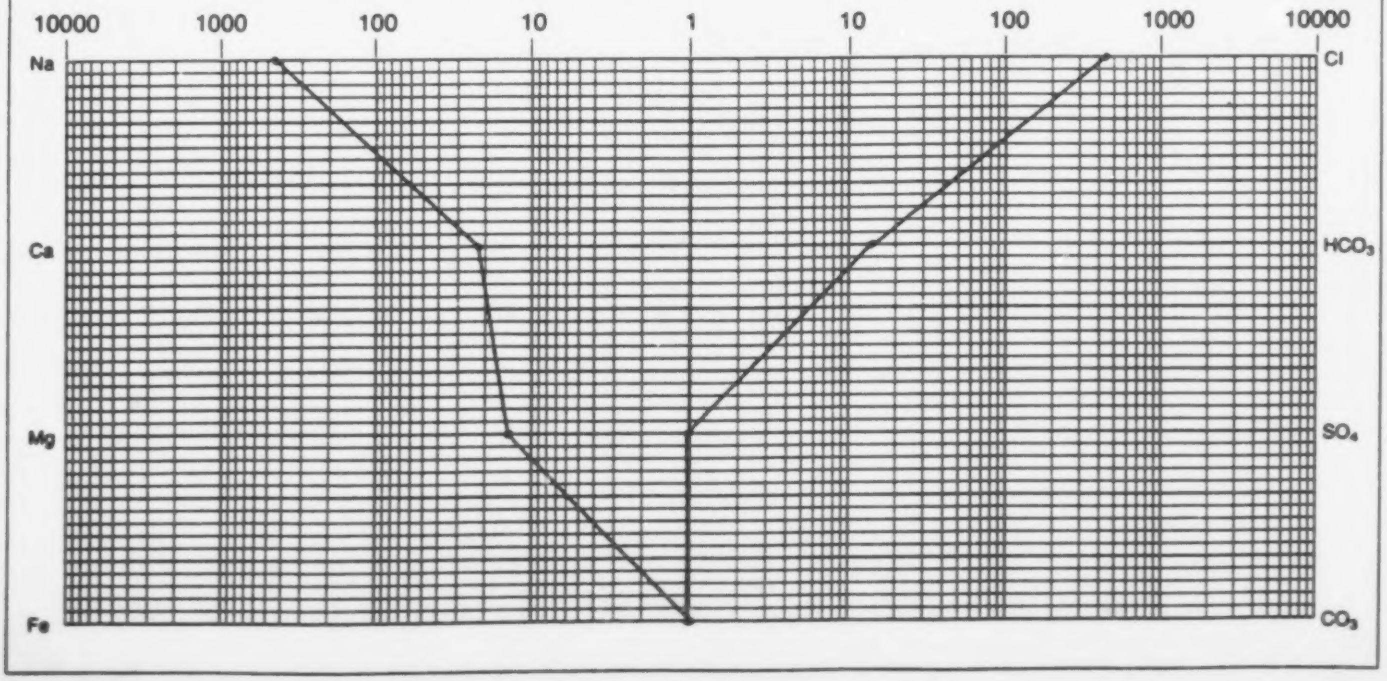
OBSERVED pH @ 27 °C: 7.17
DENSITY @ 15°C, g/ml:
RESISTIVITY @ 25°C, ohm - cm:
CONDUCTIVITY @ 25°C, µs/cm: 43 200
OIL AND GREASE, mg/L:
TOTAL HARDNESS, mg/L: 1 876 (calc)
TOTAL DISSOLVED SOLIDS, mg/L: 27 590 (calc)
TOTAL SUSPENDED SOLIDS, mg/L:
VOLATILE SUSPENDED SOLIDS, mg/L:
FIXED SUSPENDED SOLIDS, mg/L:

Surface Tension 59.7

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 120	440
Ca	447	22
Mg	185	15
Fe	9.08	1
K	266	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	15 662	442
HCO_3	897	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



0943 - 8509

Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A15-2-50-22		FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR MONTH DAY 1987 09 02	LAB SAMPLE NUMBER
FORMATION Waseca	FIELD		DATE YEAR MONTH DAY 1987 09 21
DATE SAMPLED YEAR MONTH DAY 1987 08 21 (08:15)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 7.22
DENSITY @ 15°C, g/ml
RESISTIVITY @ 25°C, ohm - cm
CONDUCTIVITY @ 25°C, µs/cm 42 500
OIL AND GREASE, mg/L

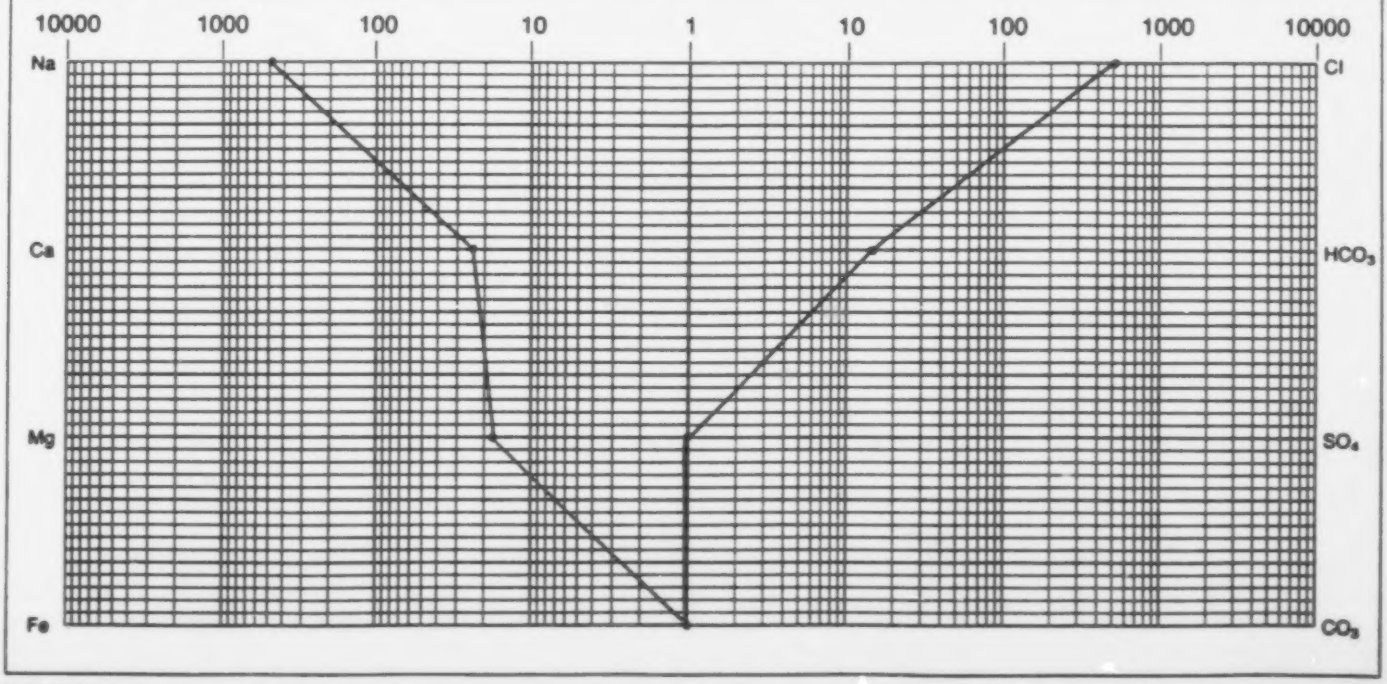
TOTAL HARDNESS, mg/L 2 030 (calc)
TOTAL DISSOLVED SOLIDS, mg/L 30 370 (calc)
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 61.6

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 280	491
Ca	484	24
Mg	200	17
Fe	7.17	0
K	276	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	17 908	505
HCO_3	902	15
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	10	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meg/L)



0343 - 8908

Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A5-2-50-22 Satellite	FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman	DATE ANALYSED 1987 09 02	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE 1987 09 21
DATE SAMPLED 1987 08 19 (14:00)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic
		PRESERVATIVE(S)

OBSERVED pH @ 22 °C 6.98

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, µs/cm 46 900

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2 120 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 32 820 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

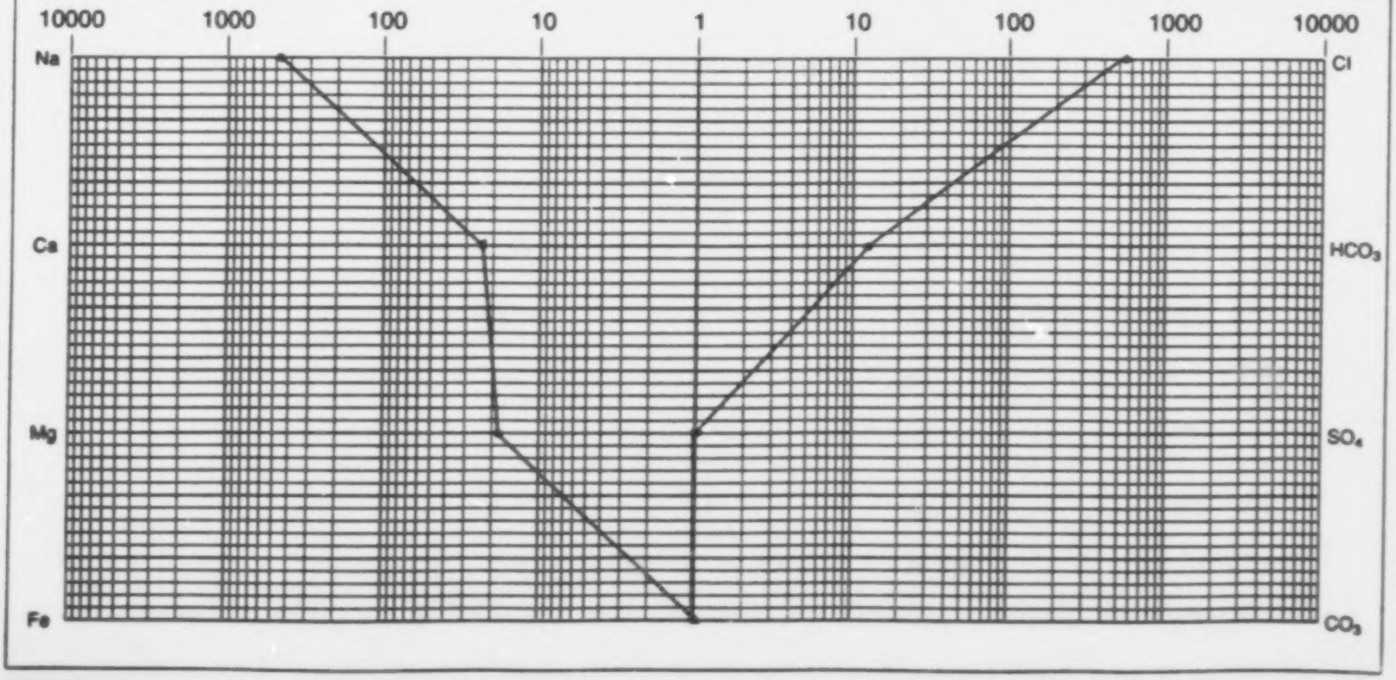
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 70.4

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 200	487
Ca	487	24
Mg	219	18
Fe	10.41	1
K	306	8
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	19 800	558
HCO_3	795	13
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill		LOCATION A5-2-50-22 Satellite	FILE REFERENCE NUMBER P4-87
ANALYST Ann Rehman		DATE ANALYSED YEAR MONTH DAY 1987 | 09 | 02	LAB SAMPLE NUMBER
FORMATION Waseca		FIELD	DATE YEAR MONTH DAY 1987 | 09 | 21
DATE SAMPLED YEAR MONTH DAY 1987 | 08 | 20 (08:45)	SAMPLED BY	SAMPLE CONTAINER(S) 1 litre plastic	PRESERVATIVE(S)

OBSERVED pH @ 22 °C 6.86

DENSITY @ 15°C, g/ml

RESISTIVITY @ 25°C, ohm - cm

CONDUCTIVITY @ 25°C, µs/cm 44 900

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 1 780 (calc)

TOTAL DISSOLVED SOLIDS, mg/L 29 120 (calc)

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

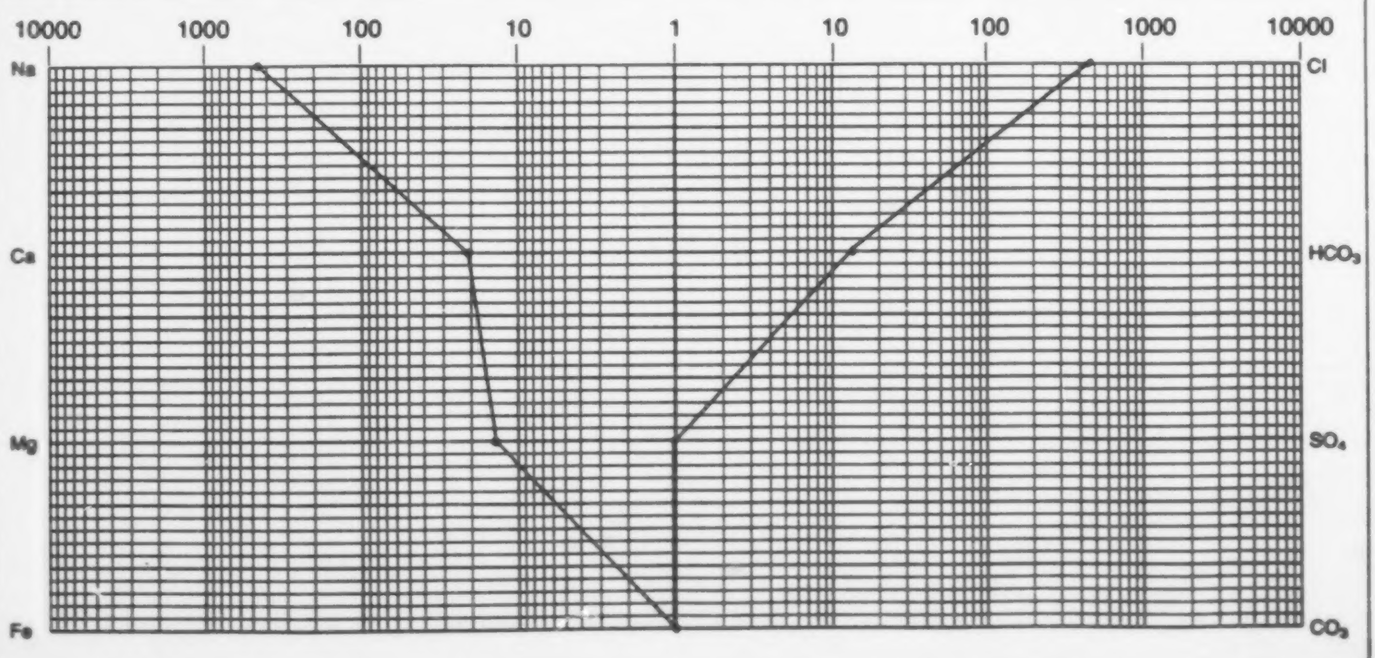
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension 56.5

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 740	467
Ca	412	21
Mg	183	15
Fe	16.57	1
K	267	7
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	16 663	470
HCO_3	829	14
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	13	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME: Standard Hill
LOCATION: A5-2-50-22 Satellite
FILE REFERENCE NUMBER: P4-87
ANALYST: Ann Rehman
DATE ANALYSED: YEAR 1987 | MONTH 09 | DAY 16
LAB SAMPLE NUMBER:
FORMATION: Waseca
FIELD:
DATE: YEAR 1987 | MONTH 09 | DAY 21
DATE SAMPLED: YEAR 1987 | MONTH 08 | DAY 21
(09:40)
SAMPLED BY:
SAMPLE CONTAINER(S): 1 litre plastic
PRESERVATIVE(S):

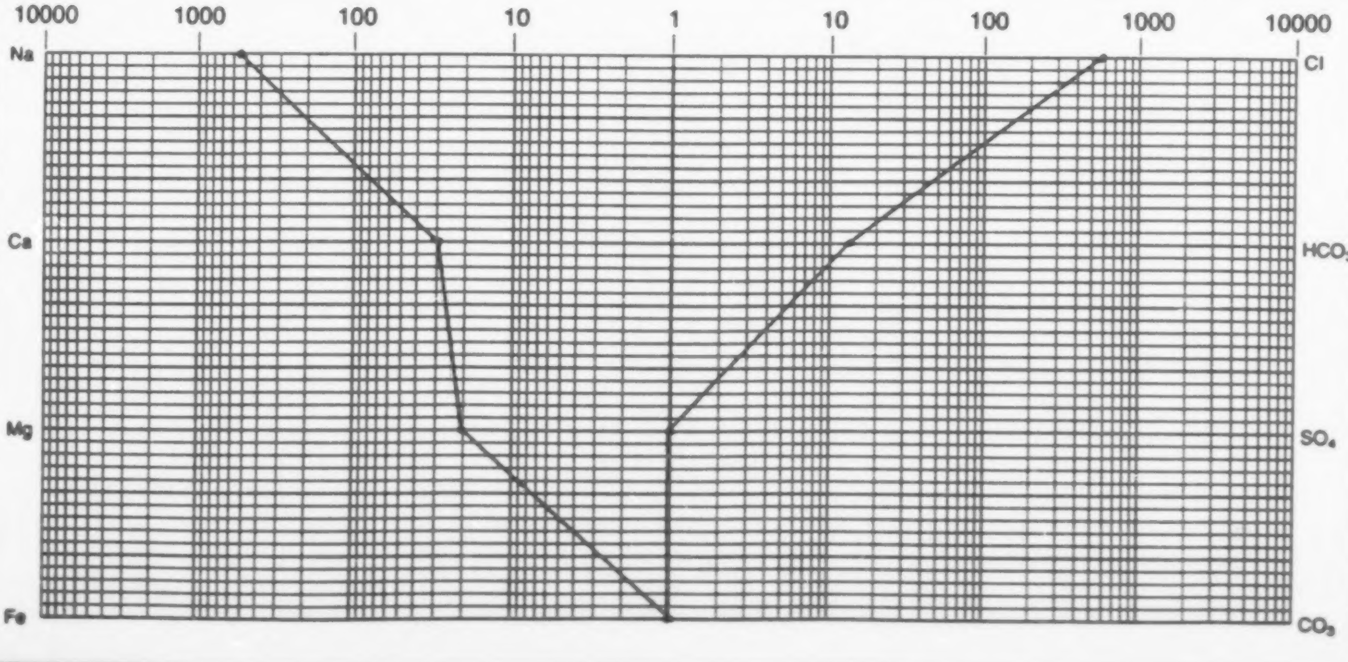
OBSERVED pH @ 22 °C 7.25
DENSITY @ 15°C, g/ml
RESISTIVITY @ 25°C, ohm - cm
CONDUCTIVITY @ 25°C, µs/cm 45 200
OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2 510 (calc)
TOTAL DISSOLVED SOLIDS, mg/L 34 780 (calc)
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

ION	CONCENTRATION	
	mg/L	meq/L
Na	12 440	541
Ca	582	29
Mg	256	21
Fe	13.87	1
K	297	8
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	20 347	574
HCO_3	839	14
SO_4	N.D.	0
CO_3	0	0
OH	0	0
NO_3	N.D.	0
PO_4	N.D.	0

LOGARITHMIC WATER PATTERN (meq/L)



MEMORANDUM

TO: L. Stehmeier

1988 SEPTEMBER 13

FROM: R. D. Dillen

REF: **DV/PDN**-(PP)

SUBJECT: **STANDARD HILL -- WATER SAMPLES**

Please find attached fifteen stiff patterns and water analyses for two (2) batches of samples taken on August 15 and 16, 1988, from the subject area.

NOTE:

We had some problems balancing the cations and anions. This interference is likely due to the well treatment.

A number of samples indicated fluoride and we have reported it as such. However, some organic acids are known to interfere on the Ion Chromatograph and we are unable to differentiate between them.

R. D. Dillen

R. D. Dillen

RDD:IBN:lef
c.c. S. Payne

Attachment

DV/PDN:045

MEMORANDUM

TO: L. Stehmeier 1988 SEPTEMBER 13

FROM: R. D. Dillen REF: **DV/PDN-**(PP)

SUBJECT: **STANDARD HILL -- WATER SAMPLES**

Two (2) batches of water samples taken on August 17 and 18, 1988, were analyzed. The water analysis and stiff patterns are attached.

R.D. Dillen

R. D. Dillen

RDD:IBN:lef
c.c. S. Payne

Attachment

DV/PDN:044

MEMORANDUM

TO: L. Stehmeier

1988 SEPTEMBER 19

FROM: R. D. Dillen

REF: **DV/PDN**-(PP)

SUBJECT: **STANDARD HILL -- WATER SAMPLES**

Two (2) batches of samples taken on August 19th and 20th, 1988 were analyzed. The results are enclosed.

R. D. Dillen

R. D. Dillen

RDD:IBN:lef
c.c. S. Payne

Attachment

DV/PDN:049

MEMORANDUM

TO: L. Stehmeier 1988 SEPTEMBER 21

FROM: R. D. Dillen REF: **DV/PDN-**(PP)

SUBJECT: **STANDARD HILL WATER SAMPLES**

Please find enclosed water analysis and stiff patterns for two (2) batches of samples taken on August 21 and 23, 1988.

R. D. Dillen

R. D. Dillen

RDD:IBN:lef
c.c. S. Payne

Attachment

DV/PDN:053

Husky

HEAVY OIL LABORATORY WATER ANALYSIS

(1)

WELL NAME Standard Hill	LOCATION A1-3-50-22	FILE REFERENCE NUMBER DV/PDN:045
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 08 DAY 30	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 14
DATE SAMPLED YEAR 1988 MONTH 08 DAY 15 SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) No

OBSERVED pH @ 20 °C 8.99
DENSITY @ 15°C, g/ml 1.0201
RESISTIVITY @ 25°C, ohm - cm 25
CONDUCTIVITY @ 25°C, μs/cm 40 800
OIL AND GREASE, mg/L

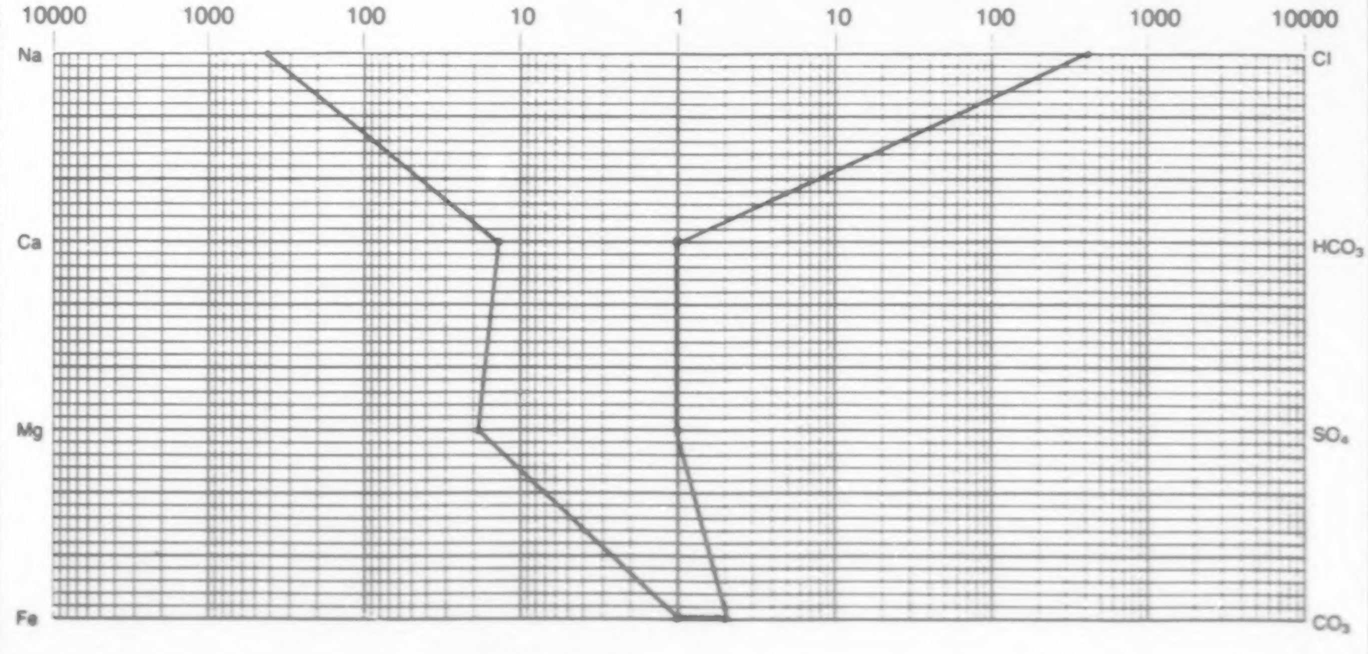
TOTAL HARDNESS, mg/L 1 710.
TOTAL DISSOLVED SOLIDS, mg/L 24,400.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 58.2 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	9 230	402
Ca	307	15
Mg	230	19
Fe	8.40	0
K	220	6
Ba		
Sr		
Mn	0.25	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	14 295	403
HCO_3	34	1
SO_4	ND	0
CO_3	47	2
OH	ND	0
PO_4	ND	0
NO_3	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky
(1)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME: Standard Hill
LOCATION: A1-3-50-22
FILE REFERENCE NUMBER: DV/PDN:044
ANALYST: I. Nowak/A. Rehman
DATE ANALYSED: YEAR 1988 MONTH 09 DAY 06
LAB SAMPLE NUMBER:
FORMATION:
FIELD:
DATE: YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED: YEAR 1988 MONTH 08 DAY 17
SAMPLED BY:
SAMPLE CONTAINER(S): Plastic
PRESERVATIVE(S): No

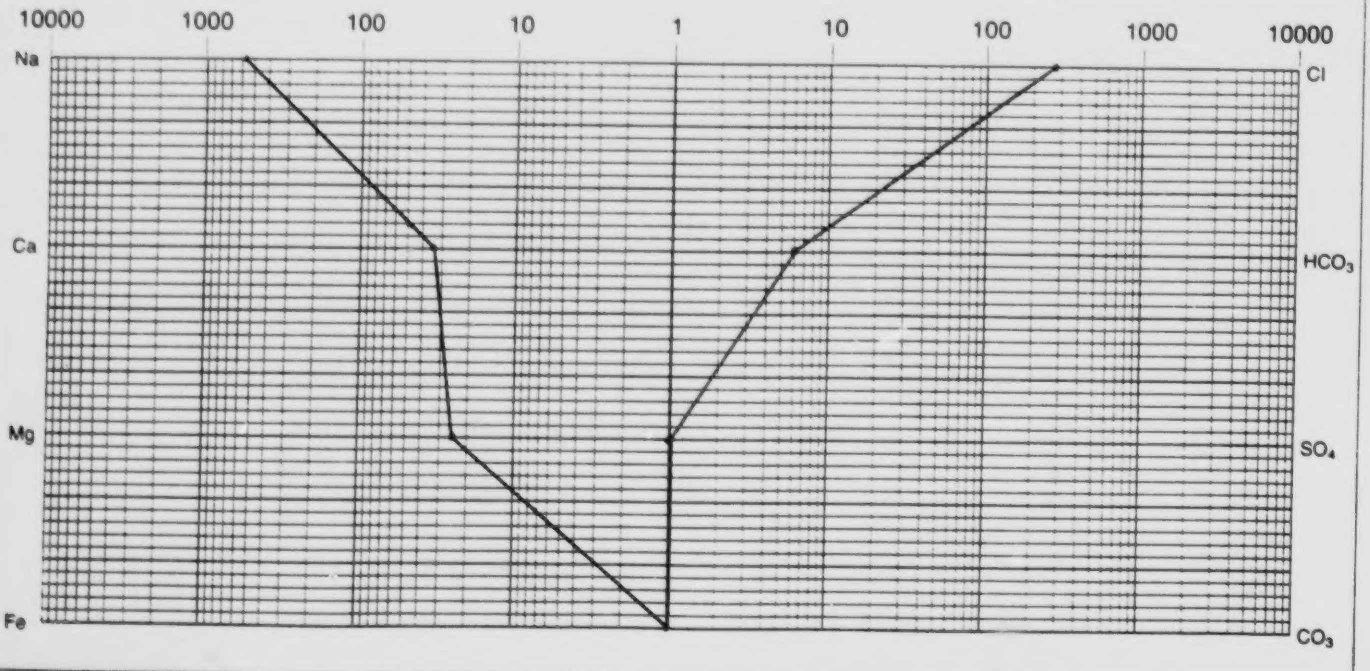
OBSERVED pH @ 21.4 °C 7.76
DENSITY @ 15°C, g/ml 1.0094
RESISTIVITY @ 25°C, ohm - cm 47
CONDUCTIVITY @ 25°C, µs/cm 21 300.
OIL AND GREASE, mg/L
TOTAL HARDNESS, mg/L 2940.
TOTAL DISSOLVED SOLIDS, mg/L 25 000.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 68.7 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	13 120	571
Ca	686	34
Mg	298	25
Fe	26.96	1
K	340	9
Ba		
Sr		
Mn	0.89	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	10 119	285
HCO_3	395	6
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	11	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky
(9)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME: Standard Hill
LOCATION: A1-3-50-22
FILE REFERENCE NUMBER: DV/PDN:044
ANALYST: I. Nowak/A. Rehman
DATE ANALYSED: YEAR 1988 | MONTH 09 | DAY 06
LAB SAMPLE NUMBER:
FORMATION:
FIELD:
DATE: YEAR 1988 | MONTH 09 | DAY 15
DATE SAMPLED: YEAR 1988 | MONTH 08 | DAY 18
SAMPLED BY:
SAMPLE CONTAINER(S): Plastic
PRESERVATIVE(S): None

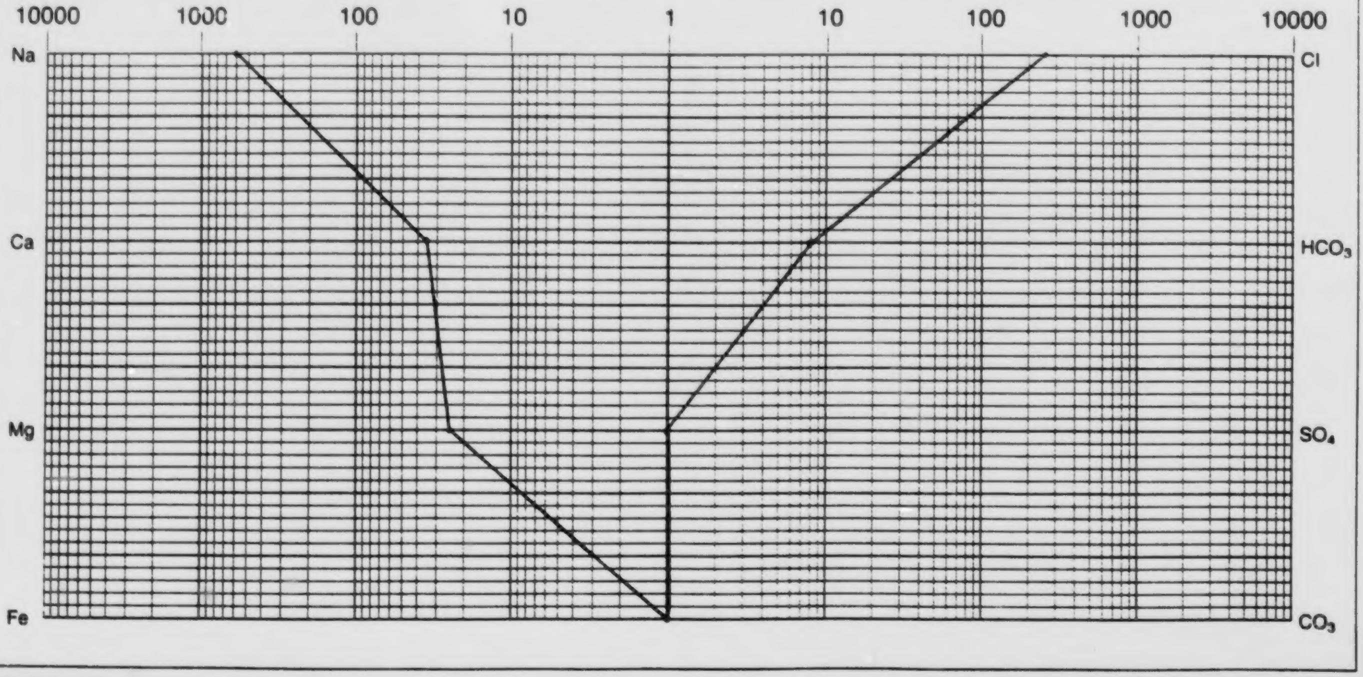
OBSERVED pH @ 22 °C: 7.28
DENSITY @ 15°C, g/ml: 1.0109
RESISTIVITY @ 25°C, ohm - cm: 42
CONDUCTIVITY @ 25°C, μs/cm: 24 300.
OIL AND GREASE, mg/L:
TOTAL HARDNESS, mg/L: 3030.
TOTAL DISSOLVED SOLIDS, mg/L: 25 200.
TOTAL SUSPENDED SOLIDS, mg/L:
VOLATILE SUSPENDED SOLIDS, mg/L:
FIXED SUSPENDED SOLIDS, mg/L:

Surface Tension - 69.7 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	13 920	606
Ca	710	35
Mg	306	25
Fe	15.92	1
K	326	8
Ba		
Sr		
Mn	0.78	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	9446	267
HCO_3	488	8
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	13	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky
(1)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A1-3-50-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 19
DATE SAMPLED YEAR 1988 MONTH 08 DAY 19	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.60
DENSITY @ 15°C, g/ml 1.0219
RESISTIVITY @ 25°C, ohm - cm 33
CONDUCTIVITY @ 25°C, μs/cm 30 400.
OIL AND GREASE, mg/L

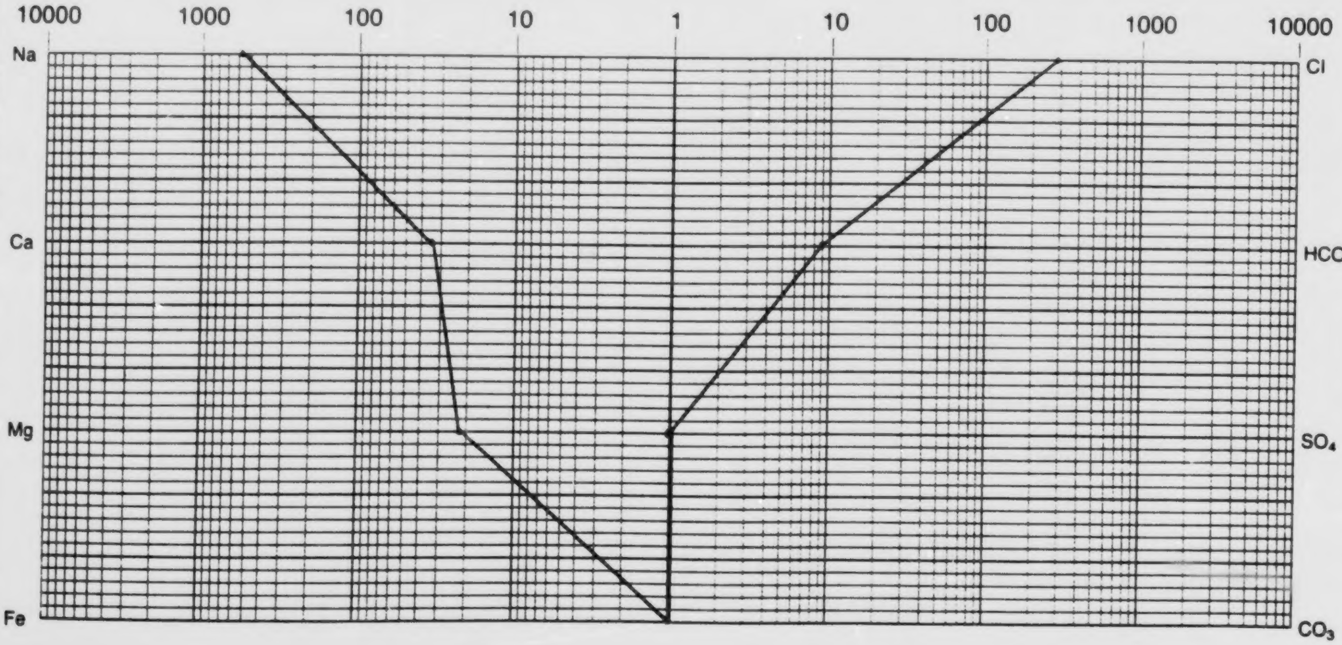
TOTAL HARDNESS, mg/L 2820.
TOTAL DISSOLVED SOLIDS, mg/L 25 500.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 68.8 dyne/cm

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Na	13 280	578
Ca	686	34
Mg	270	22
Fe	15.30	1
K	260	7
Ba		
Sr		
Mn	0.61	0
Si		

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Cl	10 430	294
HCO_3	546	9
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	16	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

(13)

WELL NAME Standard Hill	LOCATION 1-3-50-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 19

DATE SAMPLED YEAR 1988 MONTH 08 DAY 20	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.50

DENSITY @ 15°C, g/ml 1.0256

RESISTIVITY @ 25°C, ohm - cm 41

CONDUCTIVITY @ 25°C, µs/cm 24 500

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2890.

TOTAL DISSOLVED SOLIDS, mg/L 24 400.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

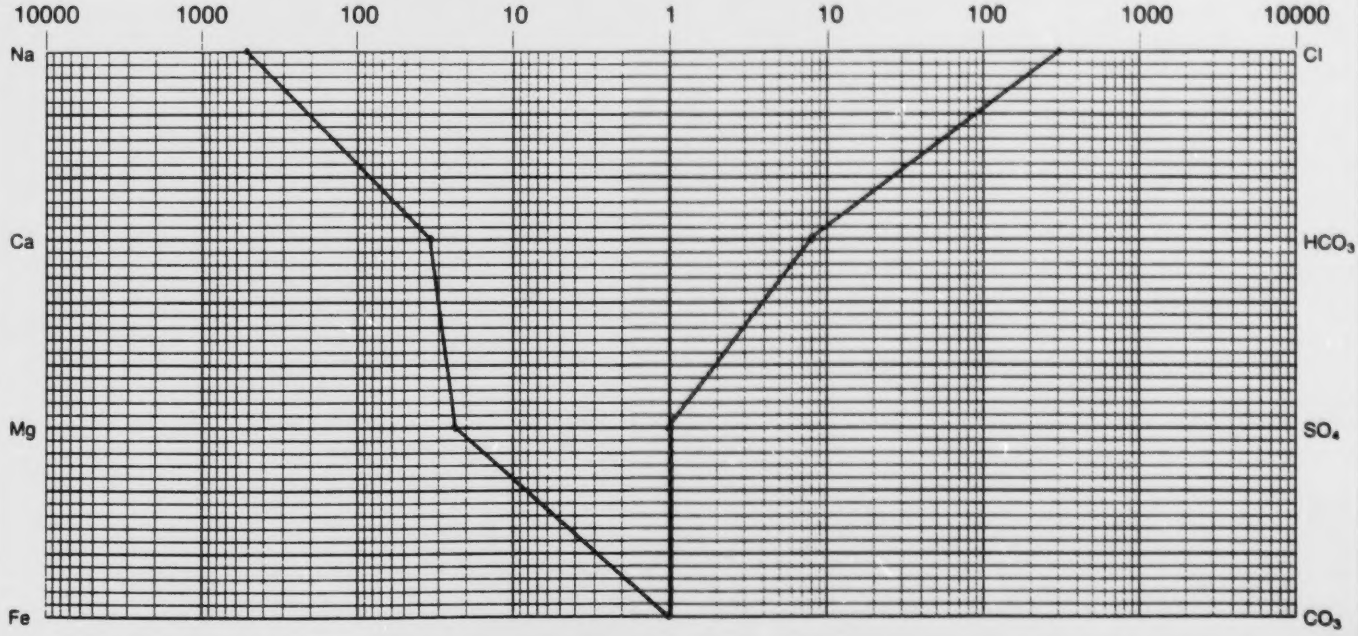
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 63.5 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 860	516
Ca	679	34
Mg	290	24
Fe	12.42	1
K	280	7
Ba		
Sr		
Mn	0.60	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	10 830	305
HCO_3	463	8
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	13	9
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

(1)

WELL NAME Standard Hill	LOCATION 1-3-50-22	FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 21

DATE SAMPLED YEAR 1988 MONTH 08 DAY 21	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

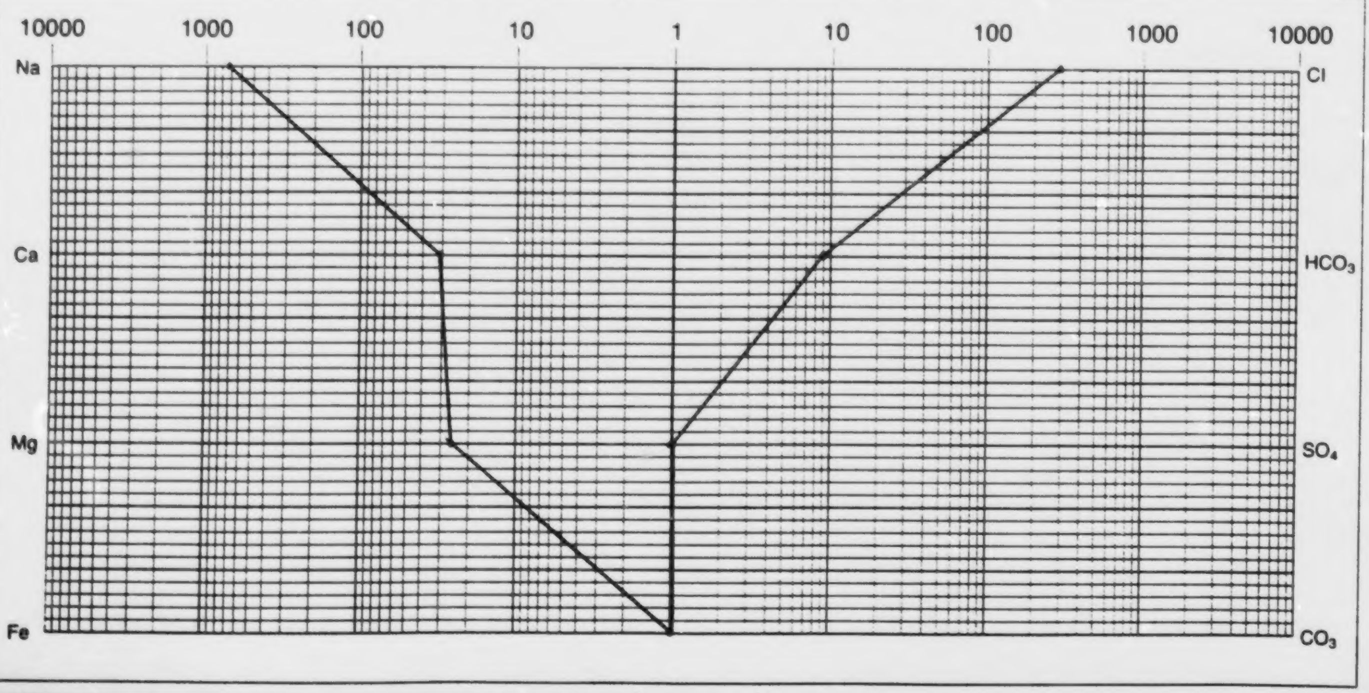
OBSERVED pH @ 22 °C	7.29	TOTAL HARDNESS, mg/L	2860.
DENSITY @ 15°C, g/ml	1.0219	TOTAL DISSOLVED SOLIDS, mg/L	29 400.
RESISTIVITY @ 25°C, ohm - cm	32	TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, μs/cm	30 500	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension - 73.0 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	16 900	735
Ca	629	31
Mg	315	26
Fe	15.11	1
K	340	9
Ba		
Sr		
Mn	0.58	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	10 600	299
HCO_3	571	9
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	17	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

(12)

WELL NAME Standard Hill	LOCATION 1-3-50-22	FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 21
DATE SAMPLED YEAR 1988 MONTH 08 DAY 23	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
PRESERVATIVE(S) None		

OBSERVED pH @ 22 °C 6.91

DENSITY @ 15°C, g/ml 1.0229

RESISTIVITY @ 25°C, ohm - cm 40

CONDUCTIVITY @ 25°C, µs/cm 26 400

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2680.

TOTAL DISSOLVED SOLIDS, mg/L 21 000.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

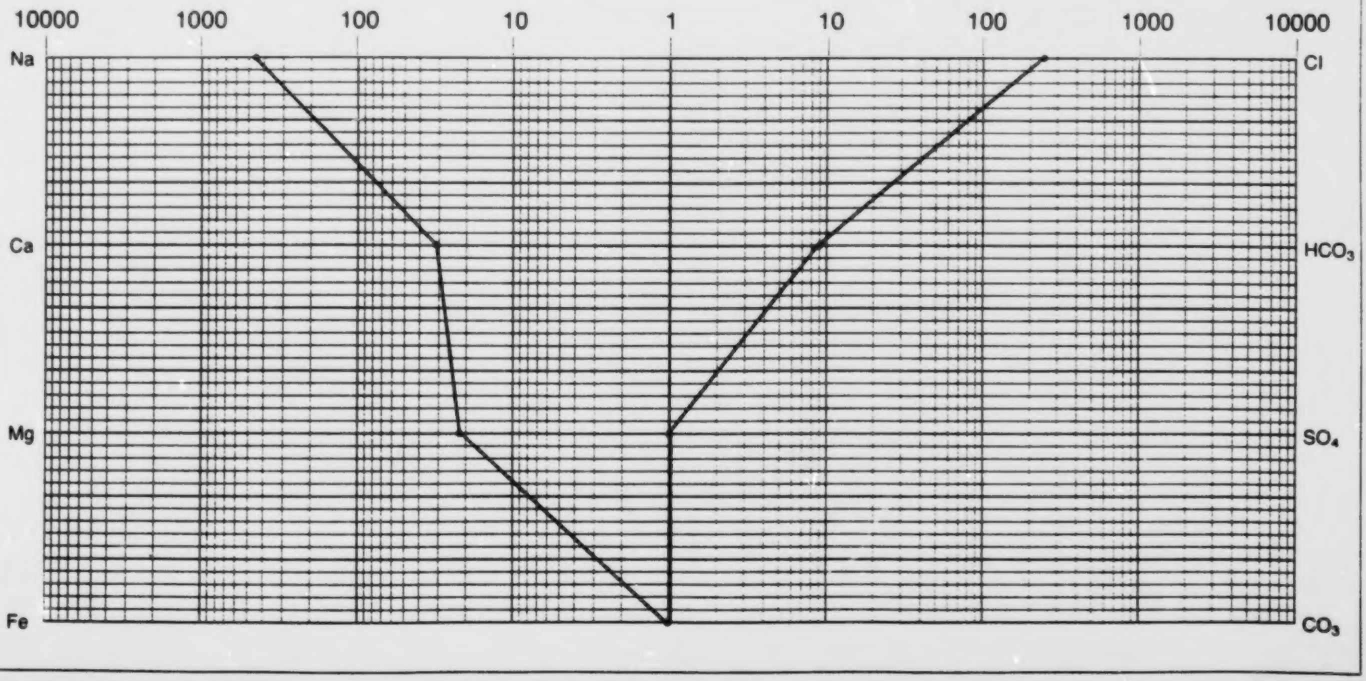
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 68.9 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 330	449
Ca	630	31
Mg	270	22
Fe	14.52	1
K	240	6
Ba		
Sr		
Mn	0.54	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	8910	251
HCO_3	556	9
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	16	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



0343 - 8509

Husky
(2)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 3-35		FILE REFERENCE NUMBER CV/PDN:045
ANALYST I. Nowak/A. Rehman		DATE ANALYSED YEAR 1988 MONTH 08 DAY 30	LAB SAMPLE NUMBER
FORMATION	FIELD		DATE YEAR 1988 MONTH 09 DAY 14
DATE SAMPLED YEAR 1988 MONTH 08 DAY 15	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) No

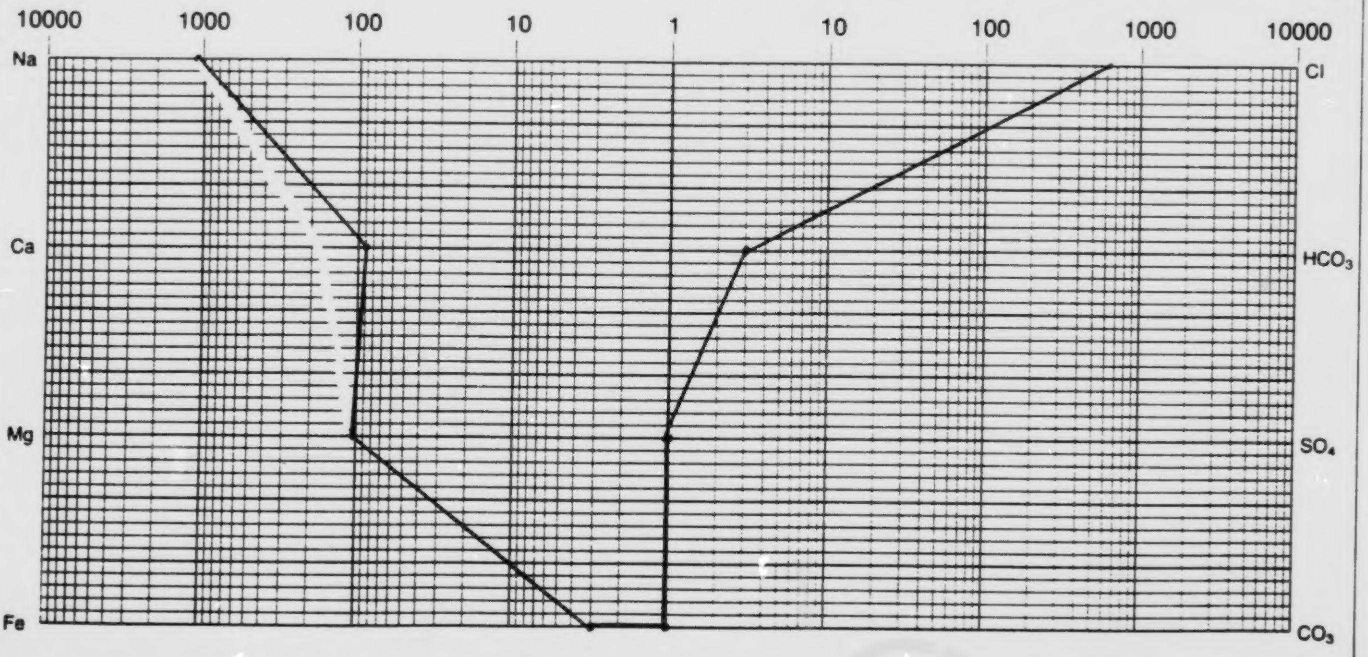
Surface Tension - 70.9 dyne/cm

OBSERVED pH @ 20.0 °C	6.59	TOTAL HARDNESS, mg/L	9 770.
DENSITY @ 15°C, g/ml	1.0442	TOTAL DISSOLVED SOLIDS, mg/L	54 100.
RESISTIVITY @ 25°C, ohm - cm	11	TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, μs/cm	80 300	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

ION	CONCENTRATION	
	mg/L	meq/L
Na	27 900	1 214
Ca	1 777	89
Mg	1 300	107
Fe	56.2	3
K	660	17
Ba		
Sr		
Mn	1.78	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	22 277	628
HCO_3	171	3
SO_4	ND	0
CO_3	ND	0
OH	ND	0
NO_3	ND	0
SO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky

(10)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A3-35-49-22	FILE REFERENCE NUMBER DV/PDN:045
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 08 DAY 30	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 14

DATE SAMPLED YEAR 1988 MONTH 08 DAY 16	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) No

OBSERVED pH @ 20.5 °C 7.26

DENSITY @ 15°C, g/ml 1.0214

RESISTIVITY @ 25°C, ohm - cm 21

CONDUCTIVITY @ 25°C, µs/cm 46 700

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2838

TOTAL DISSOLVED SOLIDS, mg/L 26 000.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

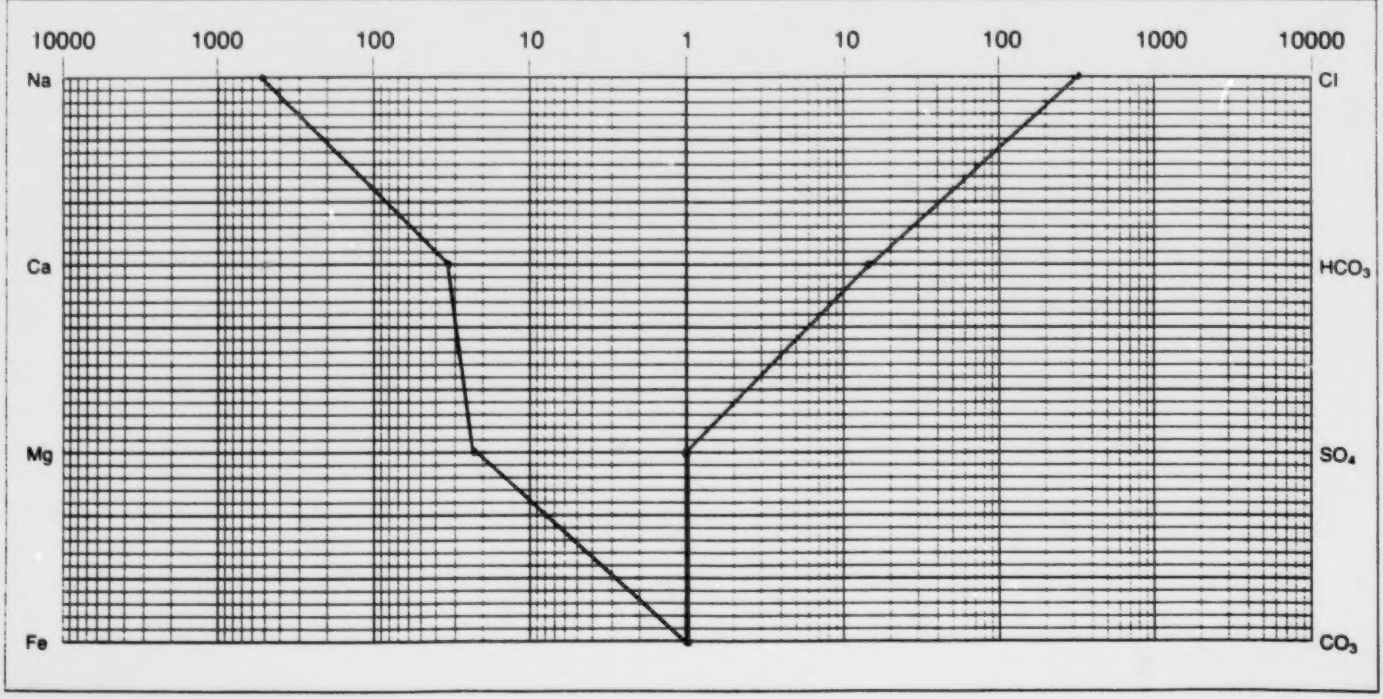
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 70.9 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 520	501
Ca	676	34
Mg	280	23
Fe	26.61	1
K	460	12
Ba		
Sr		
Mn	0.72	
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	12 136	342
HCO_3	888	15
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	23	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



0343 - 8509

Husky

(2)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A3-35-49-22	FILE REFERENCE NUMBER DV/PDN:044
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 06	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED YEAR 1988 MONTH 08 DAY 17	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) No

OBSERVED pH @ 21.4 °C 7.41

DENSITY @ 15°C, g/ml 1.0214

RESISTIVITY @ 25°C, ohm - cm 24

CONDUCTIVITY @ 25°C, μs/cm 42 200.

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2250.

TOTAL DISSOLVED SOLIDS, mg/L 23 300.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

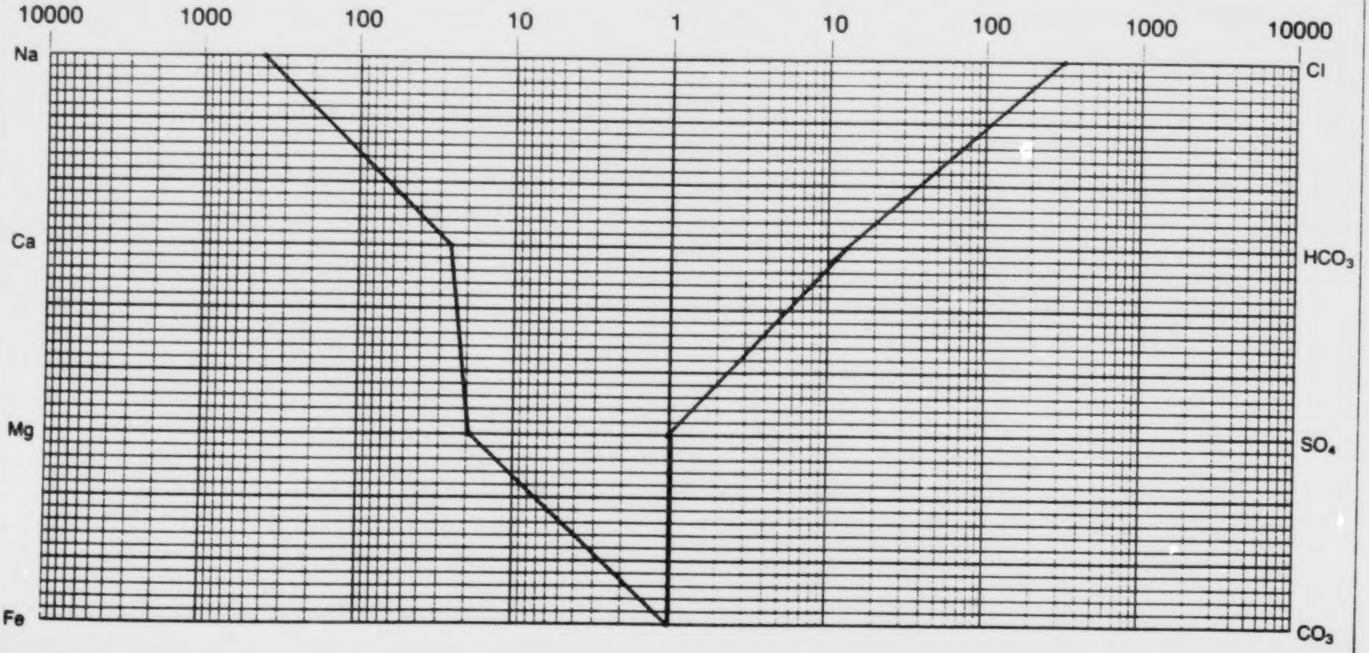
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 71.4 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	9600	418
Ca	516	26
Mg	233	19
Fe	8.14	0
K	250	7
Ba		
Sr		
Mn	0.49	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	11 765	332
HCO_3	878	14
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	23	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky

HEAVY OIL LABORATORY WATER ANALYSIS

(10)

WELL NAME Standard Hill	LOCATION A3-35-49-22		FILE REFERENCE NUMBER DV/PDN:044
ANALYST I. Nowak/A. Rehman		DATE ANALYSED YEAR 1988 MONTH 09 DAY 06	LAB SAMPLE NUMBER
FORMATION	FIELD		DATE YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED YEAR 1988 MONTH 08 DAY 18	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.53

DENSITY @ 15°C, g/ml 1.0111

RESISTIVITY @ 25°C, ohm - cm 39

CONDUCTIVITY @ 25°C, µs/cm 24 700.

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2430.

TOTAL DISSOLVED SOLIDS, mg/L 20 200.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

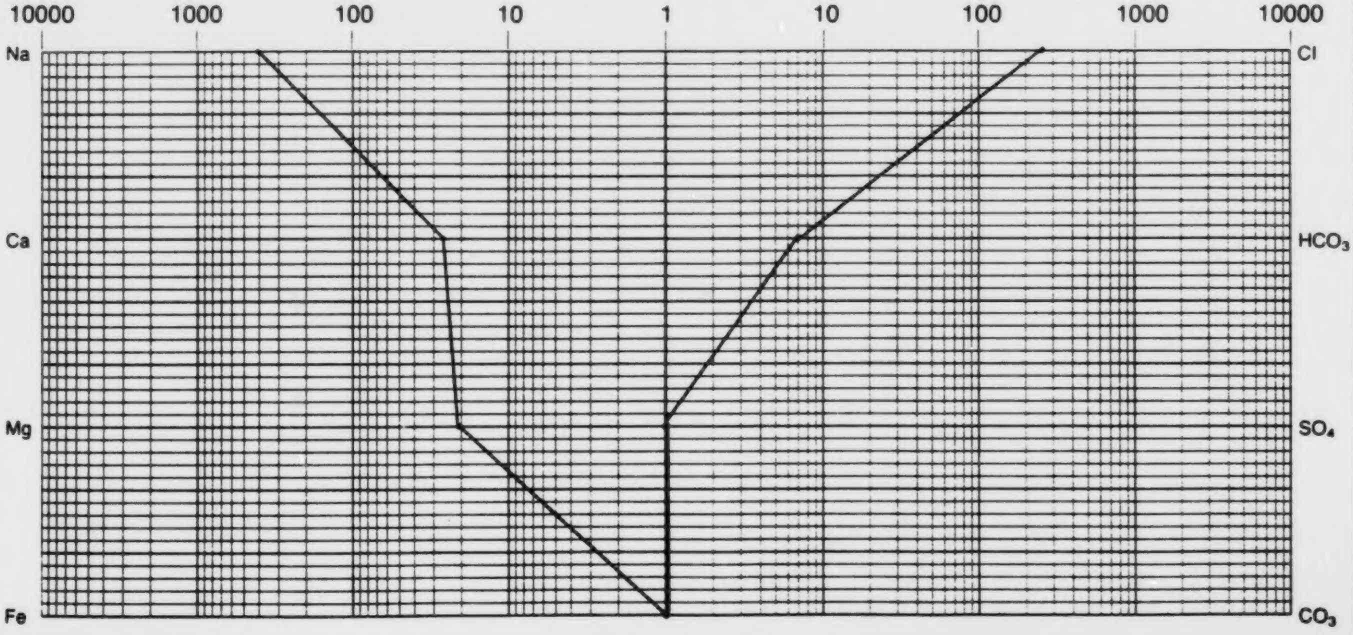
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 71.7 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	9260	403
Ca	547	27
Mg	258	21
Fe	5.61	0
K	252	6
Ba		
Sr		
Mn	0.46	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	9487	268
HCO_3	424	7
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	ND	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky
(2)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A3-35-49-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 19
DATE SAMPLED YEAR 1988 MONTH 08 DAY 19	SAMPLED BY	
SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None	

OBSERVED pH @ 22 °C 7.21
DENSITY @ 15°C, g/ml 1.0177
RESISTIVITY @ 25°C, ohm - cm 44
CONDUCTIVITY @ 25°C, µs/cm 22 900.
OIL AND GREASE, mg/L

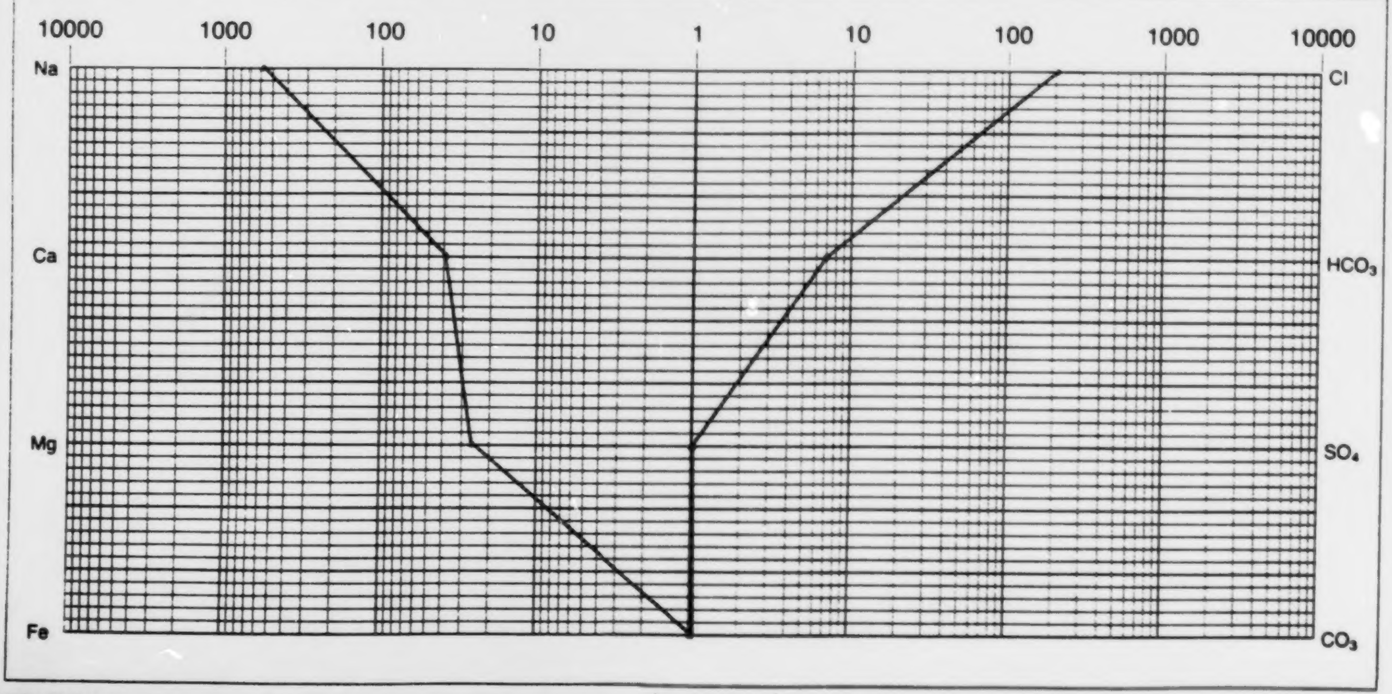
TOTAL HARDNESS, mg/L 3250.
TOTAL DISSOLVED SOLIDS, mg/L 22 700.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 73.0 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	13 760	599
Ca	788	39
Mg	312	26
Fe	16.31	1
K	300	8
Ba		
Sr		
Mn	0.61	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	7110	201
HCO_3	439	7
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	13	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky
(14)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 3-35-49-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 19

DATE SAMPLED YEAR 1988 MONTH 08 DAY 20	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.42
DENSITY @ 15°C, g/ml 1.0223
RESISTIVITY @ 25°C, ohm - cm 24
CONDUCTIVITY @ 25°C, µs/cm 41 000.
OIL AND GREASE, mg/L

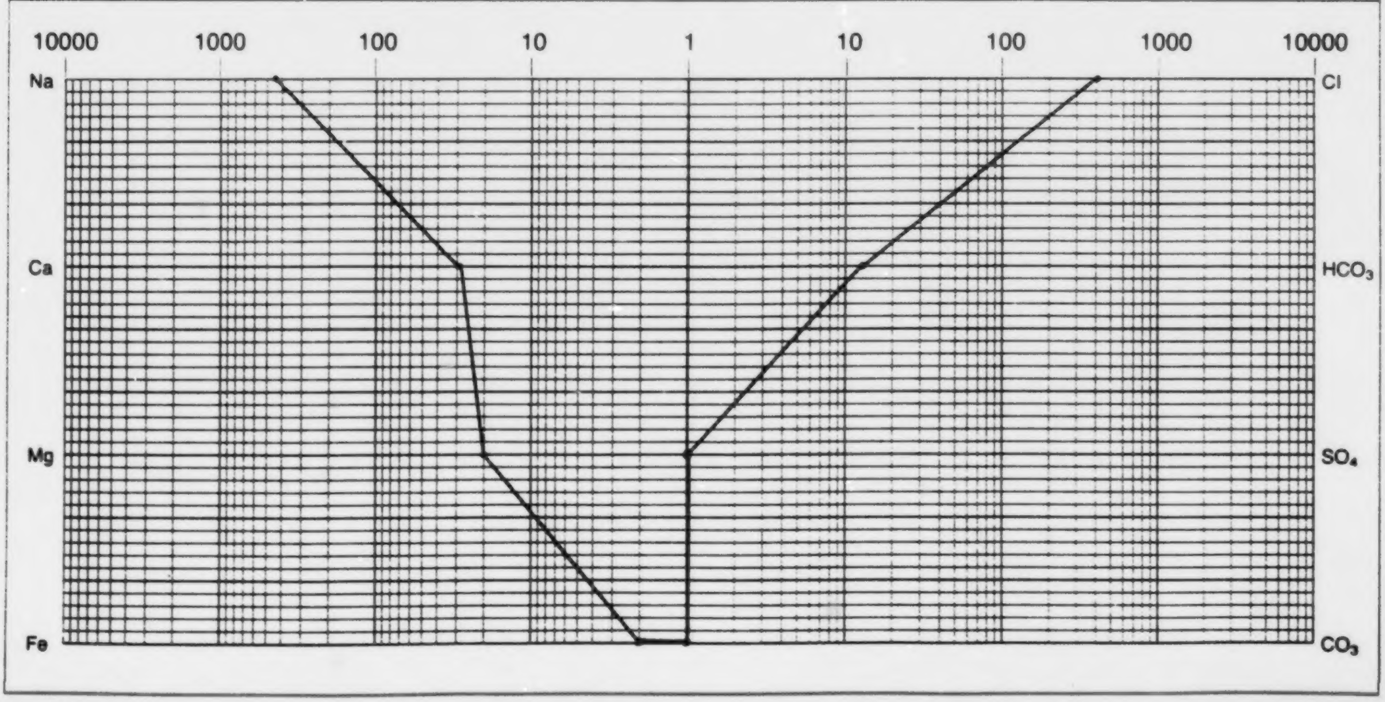
TOTAL HARDNESS, mg/L 2460.
TOTAL DISSOLVED SOLIDS, mg/L 26 700.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 64.4 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 220	445
Ca	576	29
Mg	248	20
Fe	29.07	2
K	230	6
Ba		
Sr		
Mn	0.70	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	14 530	410
HCO_3	844	14
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	23	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



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Husky

HEAVY OIL LABORATORY WATER ANALYSIS

(2)

WELL NAME Standard Hill
LOCATION 3-35-49-22
FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman
DATE ANALYSED YEAR 1988 MONTH 09 DAY 16
LAB SAMPLE NUMBER
FORMATION
FIELD
DATE YEAR 1988 MONTH 09 DAY 21
DATE SAMPLED YEAR 1988 MONTH 08 DAY 21
SAMPLED BY
SAMPLE CONTAINER(S) Plastic
PRESERVATIVE(S) None

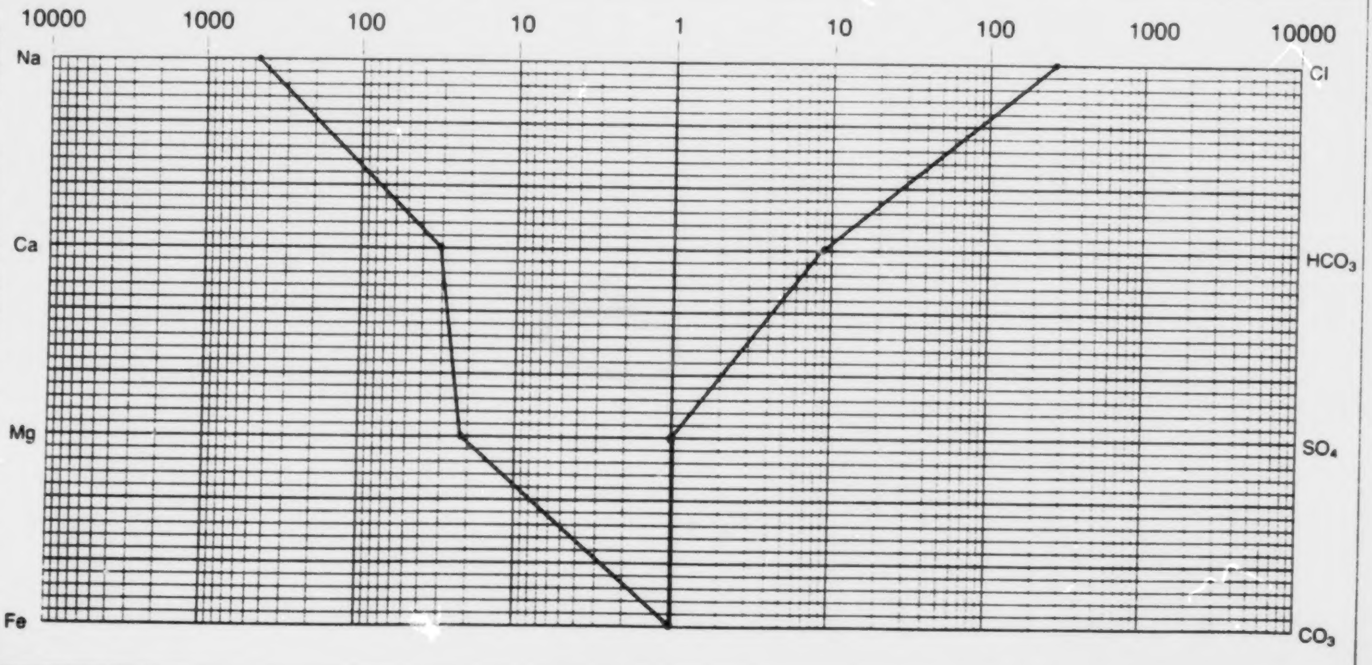
OBSERVED pH @ 22 °C	6.90
DENSITY @ 15°C, g/ml	1.0233
RESISTIVITY @ 25°C, ohm - cm	39
CONDUCTIVITY @ 25°C, µs/cm	28 700
OIL AND GREASE, mg/L	
TOTAL HARDNESS, mg/L	2660.
TOTAL DISSOLVED SOLIDS, mg/L	21 900.
TOTAL SUSPENDED SOLIDS, mg/L	
VOLATILE SUSPENDED SOLIDS, mg/L	
FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension - 74.8 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 570	460
Ca	616	31
Mg	273	22
Fe	11.44	1
K	230	6
Ba		
Sr		
Mn	0.44	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	9620	271
HCO_3	571	9
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	16	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

(13)

WELL NAME Standard Hill		LOCATION 3-35-49-22	FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman		DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD		DATE YEAR 1988 MONTH 09 DAY 21
DATE SAMPLED YEAR 1988 MONTH 08 DAY 23	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.04

DENSITY @ 15°C, g/ml 1.0226

RESISTIVITY @ 25°C, ohm - cm 34

CONDUCTIVITY @ 25°C, μs/cm 28 800

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2670.

TOTAL DISSOLVED SOLIDS, mg/L 22 700.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

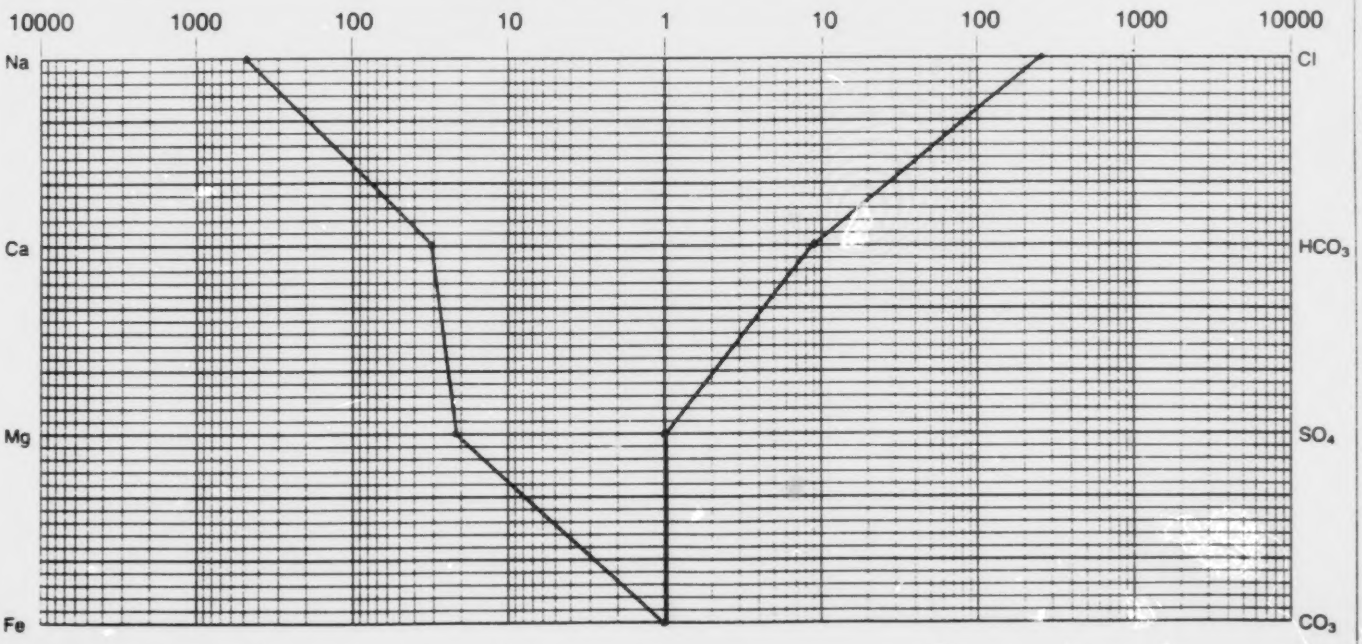
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 68.0 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 150	485
Ca	626	31
Mg	269	22
Fe	7.14	0
K	230	6
Ba		
Sr		
Mn	0.40	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	9780	276
HCO_3	571	9
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	16	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



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Husky

HEAVY OIL LABORATORY WATER ANALYSIS

(3)

WELL NAME Standard Hill	LOCATION 4-35-49-22	FILE REFERENCE NUMBER DV/PDN:045
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 08 DAY 30	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 14
DATE SAMPLED YEAR 1988 MONTH 08 DAY 15 SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) No

OBSERVED pH @ 20.0 °C 6.76

DENSITY @ 15°C, g/ml 1.0363

RESISTIVITY @ 25°C, ohm - cm 17

CONDUCTIVITY @ 25°C, µs/cm 65 900

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 7 890.

TOTAL DISSOLVED SOLIDS, mg/L 43 000.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

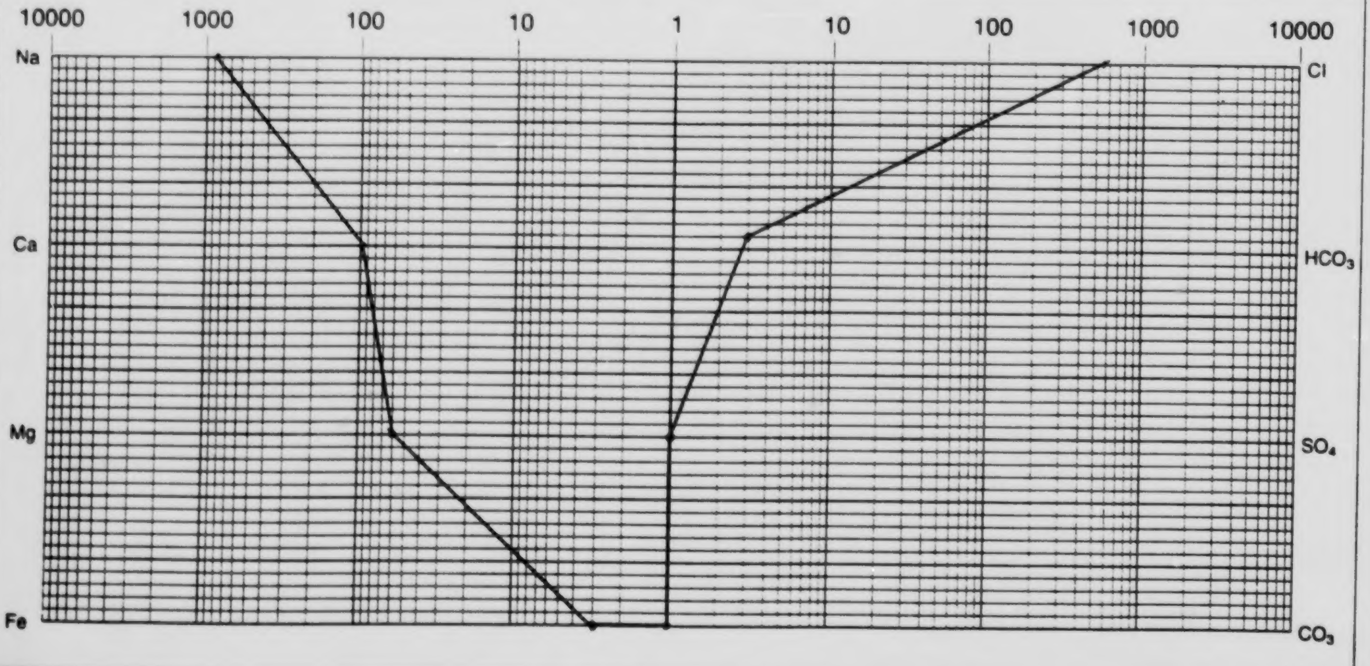
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 69.3 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	19 900	866
Ca	1 959	98
Mg	730	60
Fe	60.84	3
K	580	15
Ba		
Sr		
Mn	0.78	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	19 615	553
HCO_3	185	3
SO_4	ND	0
CO_3	ND	0
OH	ND	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky
(11)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A4-35-49-22		FILE REFERENCE NUMBER DV/PDN:045
ANALYST I. Nowak/A. Rehman		DATE ANALYSED YEAR 1988 MONTH 08 DAY 30	LAB SAMPLE NUMBER
FORMATION	FIELD		DATE YEAR 1988 MONTH 09 DAY 14
DATE SAMPLED YEAR 1988 MONTH 08 DAY 16	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) No

OBSERVED pH @ 22 °C 7.18
DENSITY @ 15°C, g/ml 1.0205
RESISTIVITY @ 25°C, ohm - cm 22
CONDUCTIVITY @ 25°C, μs/cm 43 900
OIL AND GREASE, mg/L

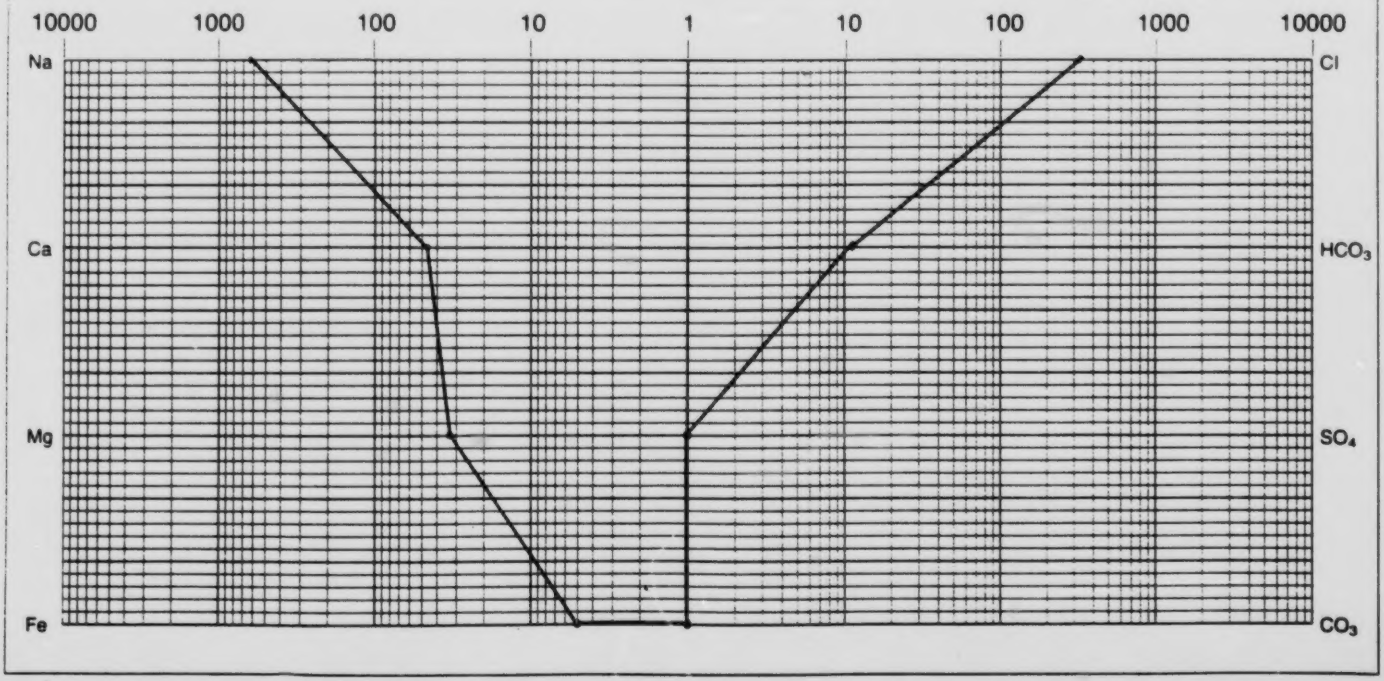
TOTAL HARDNESS, mg/L 3920.
TOTAL DISSOLVED SOLIDS, mg/L 29 400.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 60.9 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	14 830	645
Ca	911	46
Mg	400	33
Fe	86.88	5
K	560	14
Ba		
Sr		
Mn	1.45	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	11 831	334
HCO_3	742	12
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	23	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky

HEAVY OIL LABORATORY WATER ANALYSIS

(3)

WELL NAME: Standard Hill
LOCATION: A4-35-49-22
FILE REFERENCE NUMBER: DV/PDN:044
ANALYST: I. Nowak/A. Rehman
DATE ANALYSED: YEAR 1988 | MONTH 09 | DAY 06
LAB SAMPLE NUMBER:
FORMATION:
FIELD:
DATE: YEAR 1988 | MONTH 09 | DAY 15
DATE SAMPLED: YEAR 1988 | MONTH 08 | DAY 17
SAMPLED BY:
SAMPLE CONTAINER(S): Plastic
PRESERVATIVE(S): No

OBSERVED pH @ 21 °C: 7.22
DENSITY @ 15°C, g/ml: 1.0110
RESISTIVITY @ 25°C, ohm - cm: 40
CONDUCTIVITY @ 25°C, µs/cm: 24 100
OIL AND GREASE, mg/L:

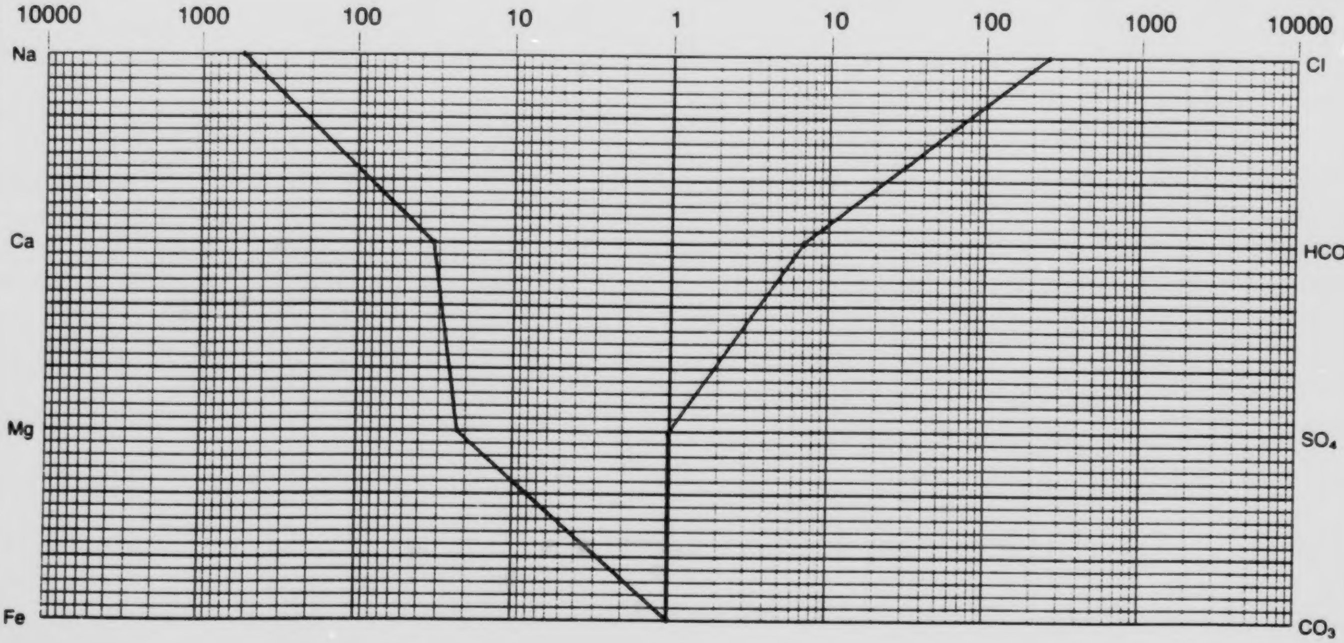
TOTAL HARDNESS, mg/L: 2750.
TOTAL DISSOLVED SOLIDS, mg/L: 23 800.
TOTAL SUSPENDED SOLIDS, mg/L:
VOLATILE SUSPENDED SOLIDS, mg/L:
FIXED SUSPENDED SOLIDS, mg/L:

Surface Tension - 72.2 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	12 630	549
Ca	644	32
Mg	278	23
Fe	11.69	1
K	328	8
Ba		
Sr		
Mn	0.63	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	9431	266
HCO_3	444	7
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	13	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
(11)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A4-35-49-22	FILE REFERENCE NUMBER DV/PDN:044
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 06	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED YEAR 1988 MONTH 08 DAY 18 SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 6.90

DENSITY @ 15°C, g/ml 1.0085

RESISTIVITY @ 25°C, ohm - cm 52

CONDUCTIVITY @ 25°C, µs/cm 19 600.

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 3040.

TOTAL DISSOLVED SOLIDS, mg/L 24 500.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

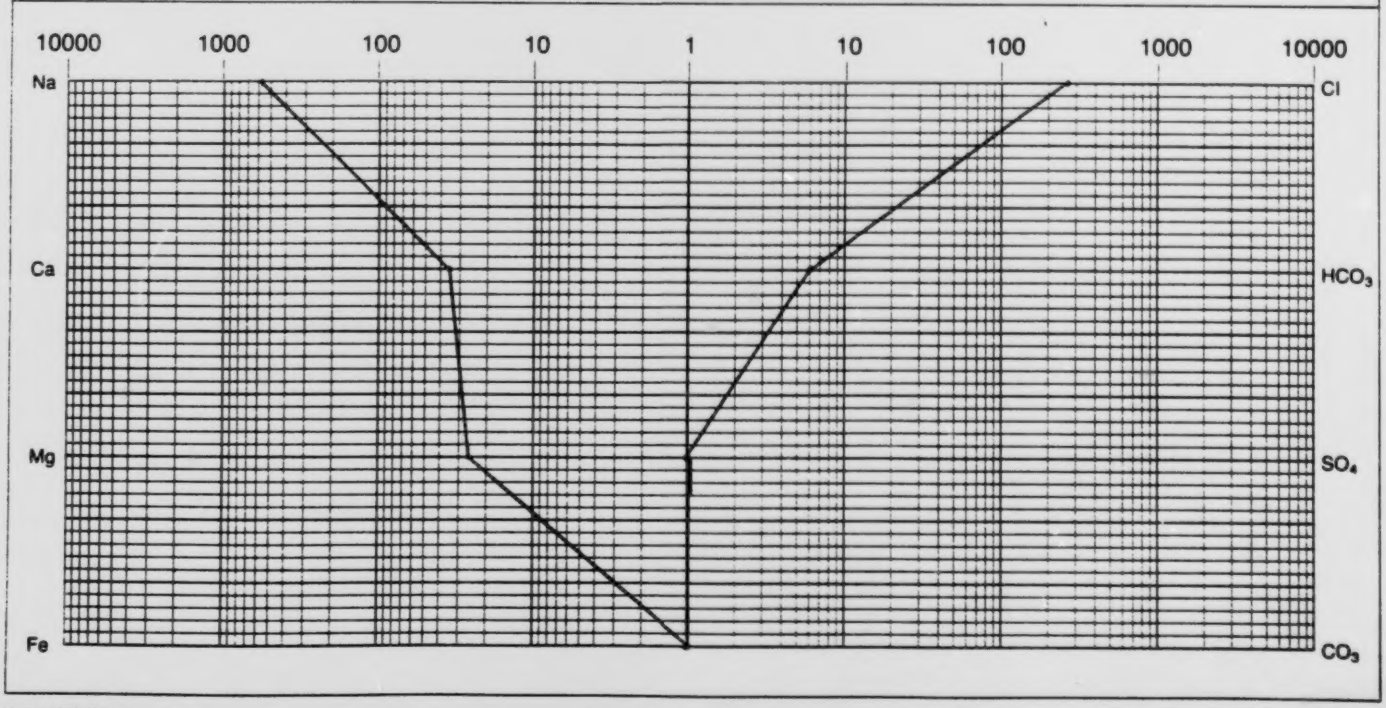
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 71.5 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	13 110	570
Ca	696	35
Mg	316	26
Fe	9.99	1
K	325	8
Ba		
Sr		
Mn	0.62	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	9695	273
HCO_3	356	6
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	10	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky
(3)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill
LOCATION A4-35-19-22
FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman
DATE ANALYSED YEAR 1988 MONTH 09 DAY 12
LAB SAMPLE NUMBER
FORMATION
FIELD
DATE YEAR 1988 MONTH 09 DAY 19
DATE SAMPLED YEAR 1988 MONTH 08 DAY 19
SAMPLED BY
SAMPLE CONTAINER(S) Plastic
PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.12
DENSITY @ 15°C, g/ml 1.0134
RESISTIVITY @ 25°C, ohm - cm 50
CONDUCTIVITY @ 25°C, μs/cm 19 500.
OIL AND GREASE, mg/L

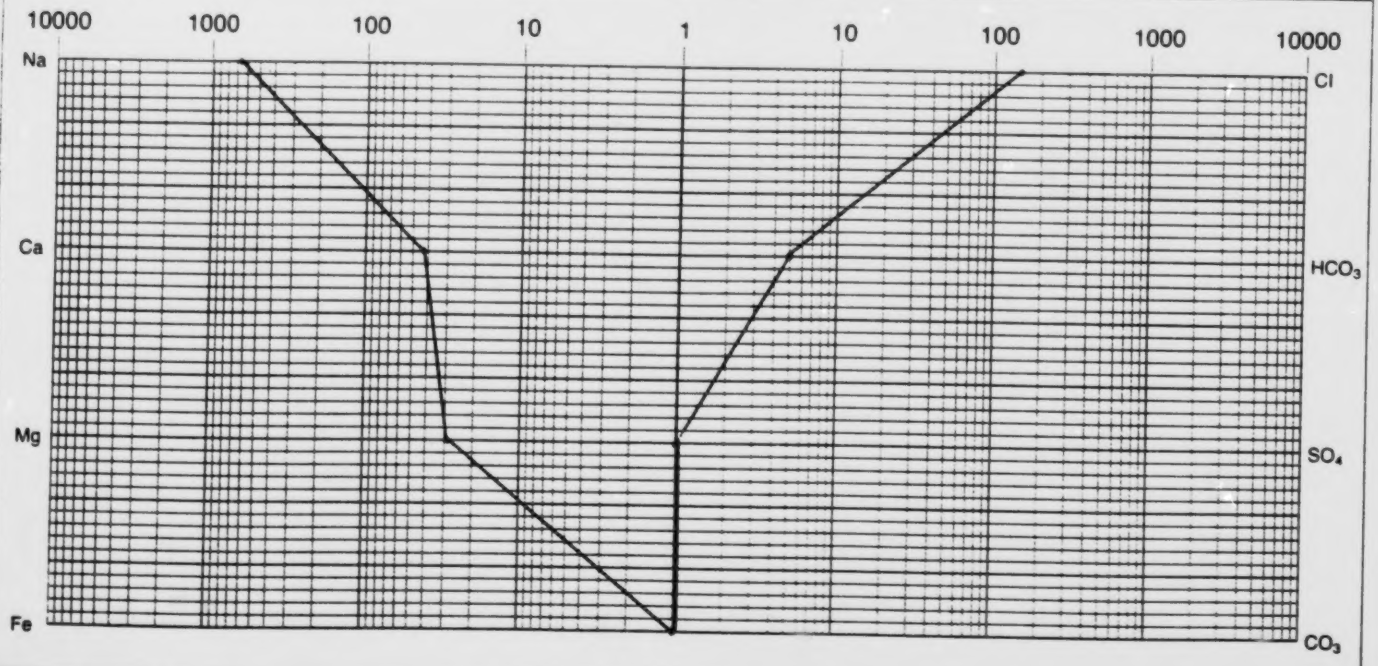
TOTAL HARDNESS, mg/L 3620.
TOTAL DISSOLVED SOLIDS, mg/L 22 700.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface TEnsion - 72.6 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	15 260	664
Ca	863	43
Mg	356	29
Fe	13.10	1
K	340	9
Ba		
Sr		
Mn	0.65	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	5520	156
HCO_3	327	5
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	10	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky
(15)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 4-35-49-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 19
DATE SAMPLED YEAR 1988 MONTH 08 DAY 20 SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.30
DENSITY @ 15°C, g/ml 1.0252
RESISTIVITY @ 25°C, ohm - cm 35
CONDUCTIVITY @ 25°C, μs/cm 29 700.
OIL AND GREASE, mg/L

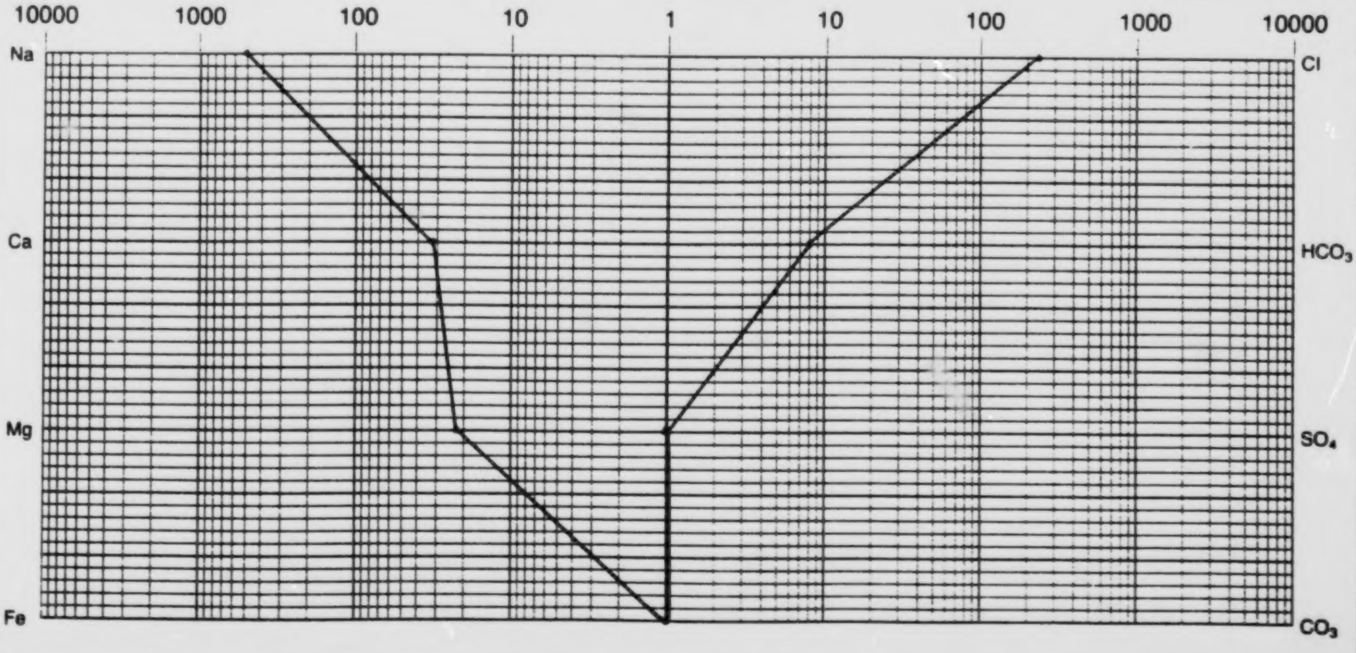
TOTAL HARDNESS, mg/L 2790.
TOTAL DISSOLVED SOLIDS, mg/L 22 400.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface TEnsion - 65.2 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 920	519
Ca	653	33
Mg	282	23
Fe	11.59	1
K	270	7
Ba		
Sr		
Mn	0.56	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	8730	246
HCO_3	512	8
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	15	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
(3)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 4-35-49-22	FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 21
DATE SAMPLED YEAR 1988 MONTH 08 DAY 21	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.0
DENSITY @ 15°C, g/ml 1.0215
RESISTIVITY @ 25°C, ohm - cm 24
CONDUCTIVITY @ 25°C, μs/cm 40 400
OIL AND GREASE, mg/L

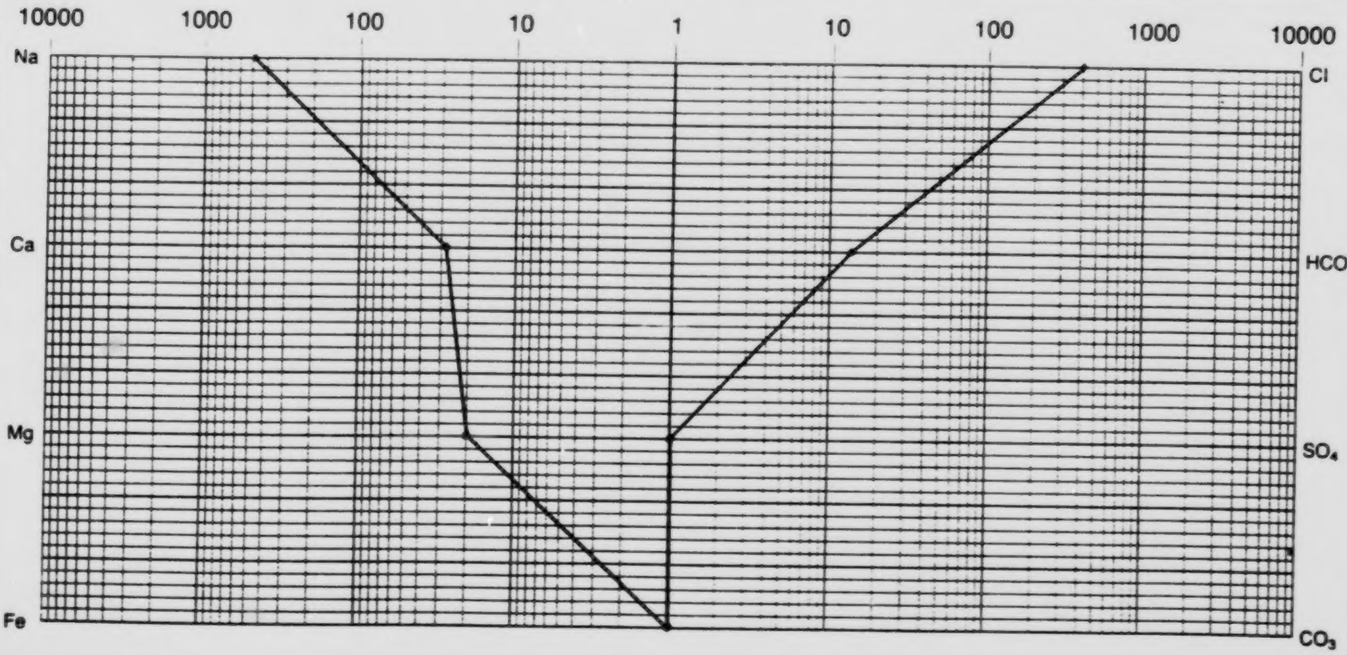
TOTAL HARDNESS, mg/L 2430
TOTAL DISSOLVED SOLIDS, mg/L 28 100
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 66.2 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 390	495
Ca	566	28
Mg	248	20
Fe	8.97	0
K	220	6
Ba		
Sr		
Mn	0.48	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	14 700	415
HCO_3	902	15
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	24	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky

(14)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 4-35-49-22	FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 21

DATE SAMPLED YEAR 1988 MONTH 08 DAY 23	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.03

DENSITY @ 15°C, g/ml 1.0218

RESISTIVITY @ 25°C, ohm - cm 23

CONDUCTIVITY @ 25°C, μs/cm 38 500

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2590.

TOTAL DISSOLVED SOLIDS, mg/L 26 500.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

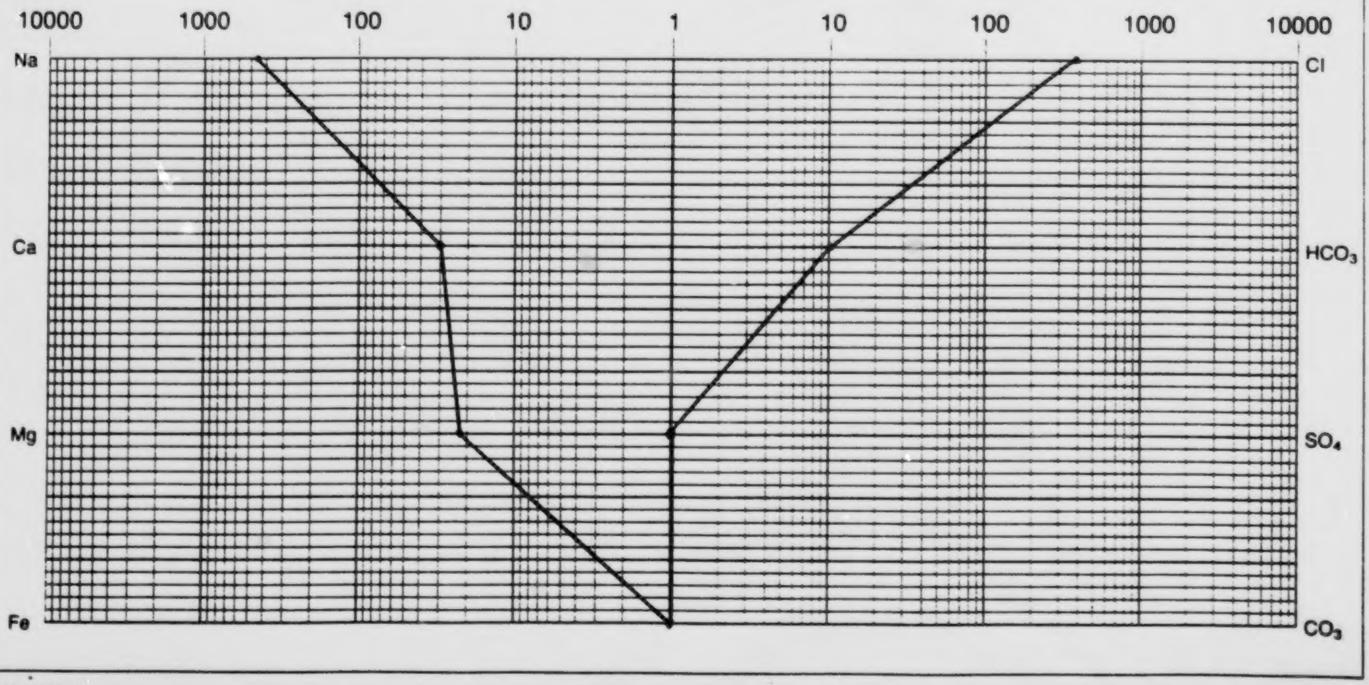
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 71.8 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 710	466
Ca	606	30
Mg	262	22
Fe	11.26	1
K	230	6
Ba		
Sr		
Mn	0.42	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	14 000	395
HCO_3	644	11
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	23	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky

(4)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME: Standard Hill

LOCATION: A5-35-49-22

FILE REFERENCE NUMBER: DV/PDN:045

ANALYST: I. Nowak/A. Rehman

DATE ANALYSED: YEAR 1988 | MONTH 08 | DAY 30

LAB SAMPLE NUMBER:

FORMATION:

FIELD:

DATE: YEAR 1988 | MONTH 09 | DAY 14

DATE SAMPLED: YEAR 1988 | MONTH 08 | DAY 15

SAMPLED BY:

SAMPLE CONTAINER(S): Plastic

PRESERVATIVE(S): No

OBSERVED pH @ 19.0 °C: 7.15

DENSITY @ 15°C, g/ml: 1.0488

RESISTIVITY @ 25°C, ohm - cm: 12

CONDUCTIVITY @ 25°C, μs/cm: 84 100

OIL AND GREASE, mg/L:

TOTAL HARDNESS, mg/L: 687 0.

TOTAL DISSOLVED SOLIDS, mg/L: 46 400.

TOTAL SUSPENDED SOLIDS, mg/L:

VOLATILE SUSPENDED SOLIDS, mg/L:

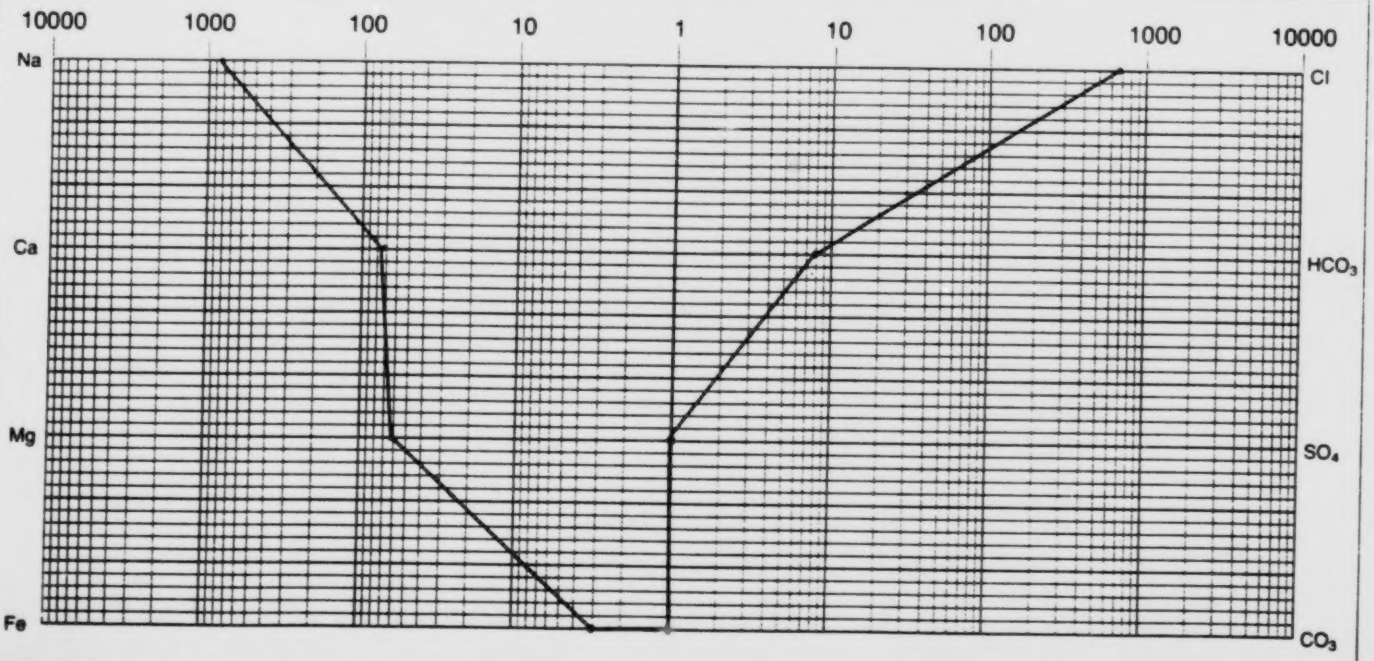
FIXED SUSPENDED SOLIDS, mg/L:

Surface Tension - 67.3 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	18 700	813
Ca	1 485	74
Mg	770	63
Fe	48	3
K	510	13
Ba		
Sr		
Mn	0.47	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	24 427	689
HCO_3	463	8
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	40	2
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



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(12)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A5-35-49-22	FILE REFERENCE NUMBER DV/PDN:045
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 08 DAY 30	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 14
DATE SAMPLED YEAR 1988 MONTH 08 DAY 16 / SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) No

OBSERVED pH @ 20 °C 7.22
DENSITY @ 15°C, g/ml 1.0227
RESISTIVITY @ 25°C, ohm - cm 21
CONDUCTIVITY @ 25°C, µs/cm 47 800
OIL AND GREASE, mg/L

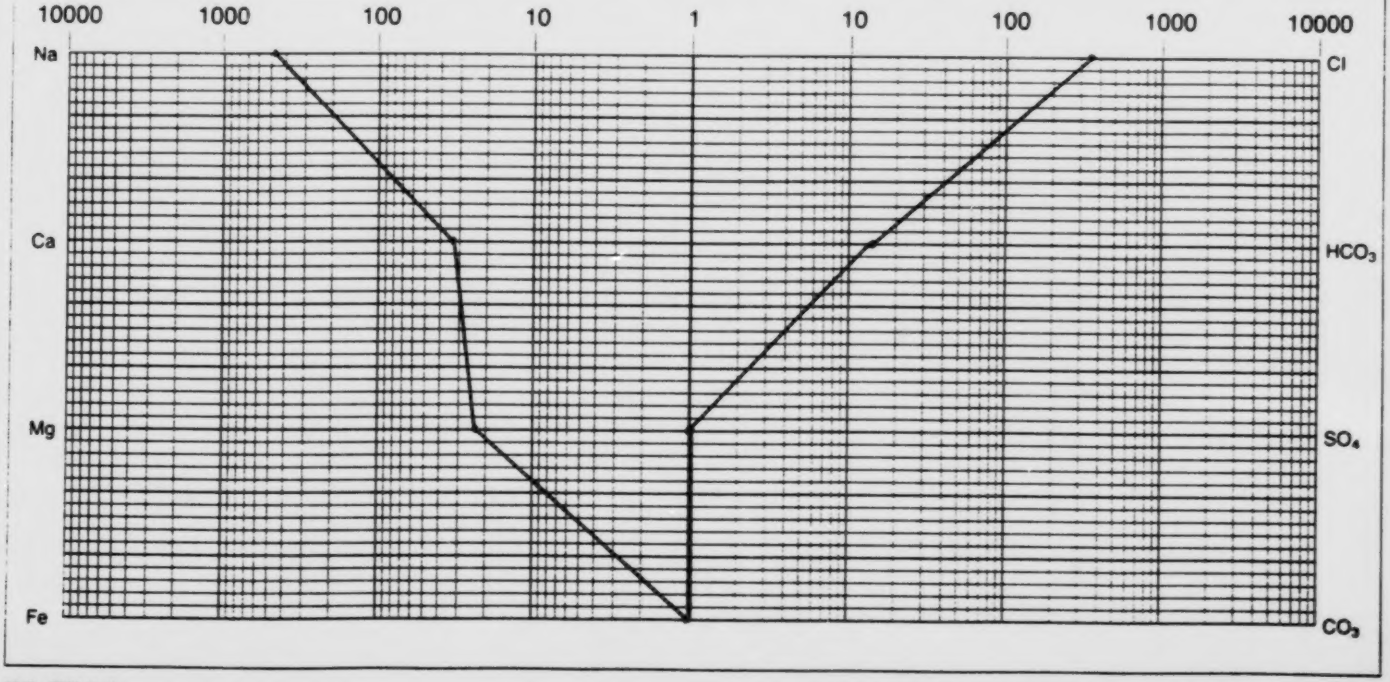
TOTAL HARDNESS, mg/L 2830.
TOTAL DISSOLVED SOLIDS, mg/L 26 500.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 73.8 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 380	495
Ca	664	33
Mg	285	24
Fe	6.31	0
K	450	12
Ba		
Sr		
Mn	0.47	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	12 735	359
HCO_3	927	15
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	24	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky

HEAVY OIL LABORATORY WATER ANALYSIS

(4)

WELL NAME Standard Hill	LOCATION A5-35-49-22	FILE REFERENCE NUMBER DV/PDN:044
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 06	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED YEAR 1988 MONTH 08 DAY 17 / SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) No

OBSERVED pH @ 21.5 °C 7.53

DENSITY @ 15°C, g/ml 1.0139

RESISTIVITY @ 25°C, ohm - cm 33

CONDUCTIVITY @ 25°C, µs/cm 39 400.

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2340.

TOTAL DISSOLVED SOLIDS, mg/L 24 400.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

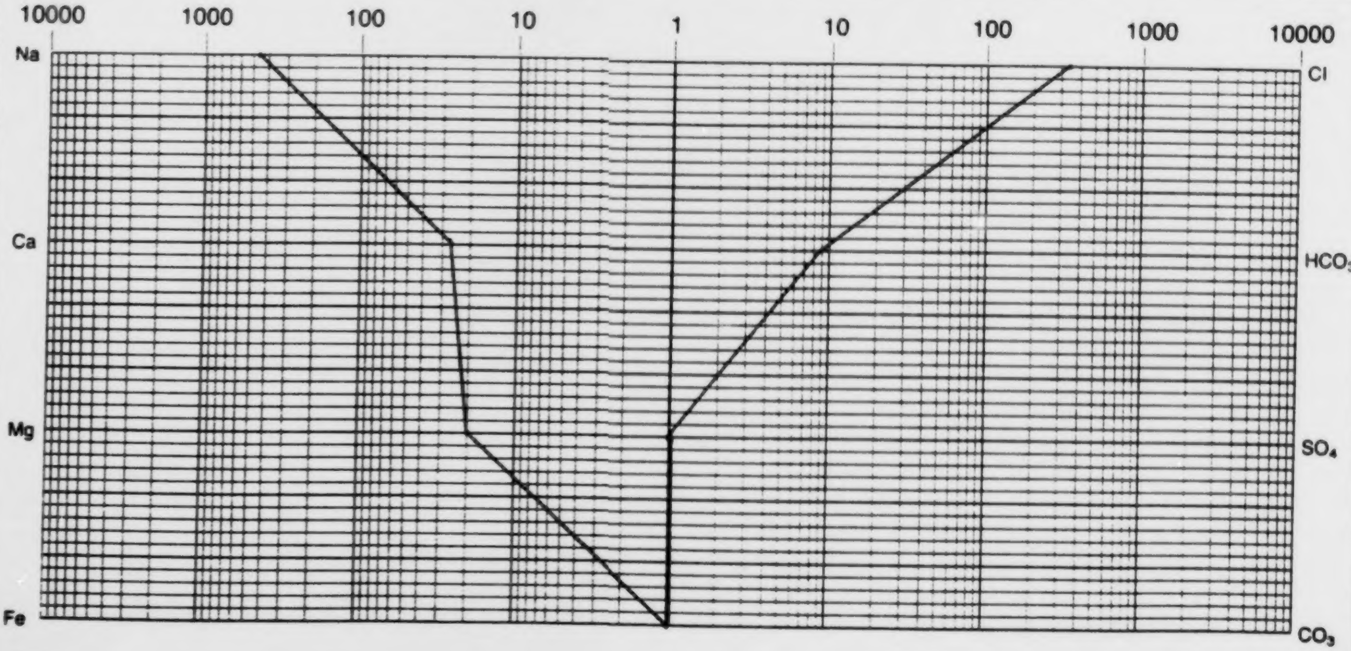
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 61.0 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 540	458
Ca	527	26
Mg	249	20
Fe	3.50	0
K	263	7
Ba		
Sr		
Mn	0.40	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	12 298	347
HCO_3	522	9
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	15	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
(12)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A5-35-49-22	FILE REFERENCE NUMBER DV/PDN:044
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 06	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 15

DATE SAMPLED YEAR 1988 MONTH 08 DAY 18	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.18
DENSITY @ 15°C, g/ml 1.0135
RESISTIVITY @ 25°C, ohm · cm 32
CONDUCTIVITY @ 25°C, µs/cm 29 500.
OIL AND GREASE, mg/L

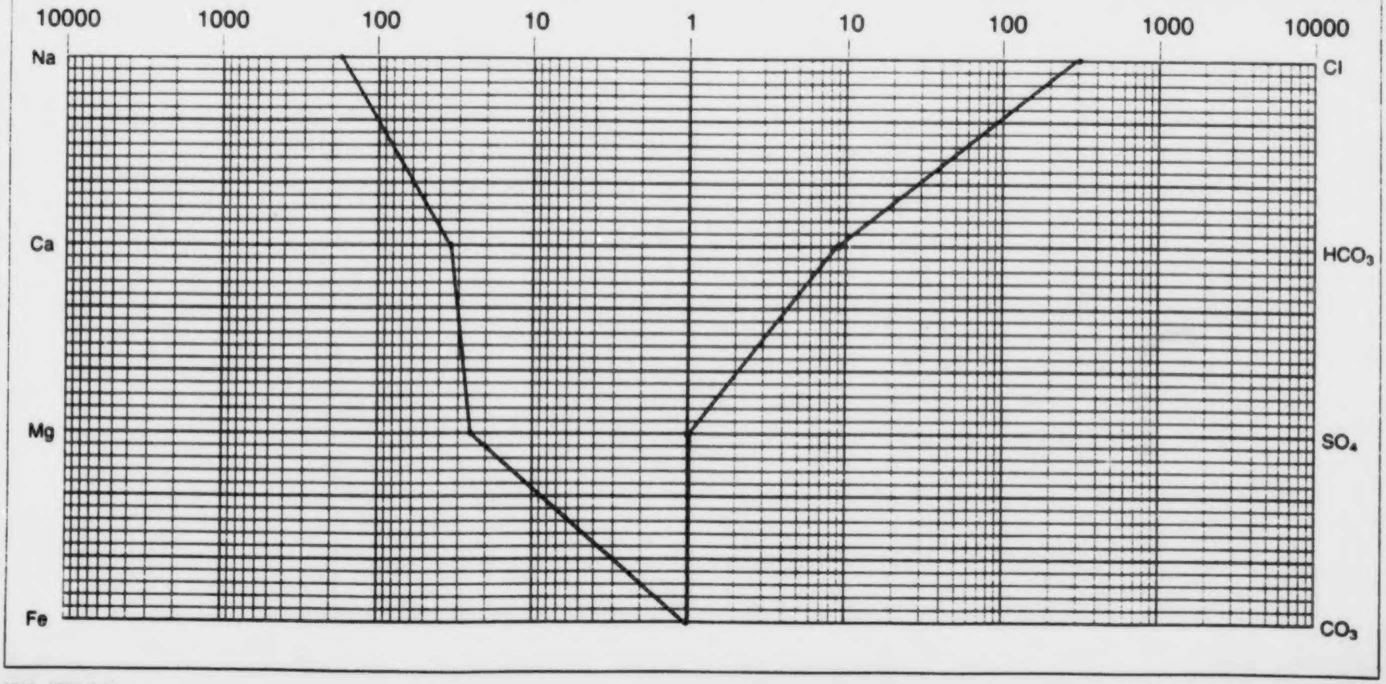
TOTAL HARDNESS, mg/L 2950.
TOTAL DISSOLVED SOLIDS, mg/L 16 800.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 68.8 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	4240	184
Ca	685	34
Mg	302	25
Fe	5.32	0
K	305	8
Ba		
Sr		
Mn	0.48	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	10 684	301
HCO_3	522	9
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	15	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
(5)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME: Standard Hill
LOCATION: A5-35-49-22
FILE REFERENCE NUMBER: DV/PDN:049
ANALYST: I. Nowak/A. Rehman
DATE ANALYSED: YEAR 1988 | MONTH 09 | DAY 12
LAB SAMPLE NUMBER:
FORMATION:
FIELD:
DATE: YEAR 1988 | MONTH 09 | DAY 19
DATE SAMPLED: YEAR 1988 | MONTH 08 | DAY 19
SAMPLED BY:
SAMPLE CONTAINER(S): Plastic
PRESERVATIVE(S): None

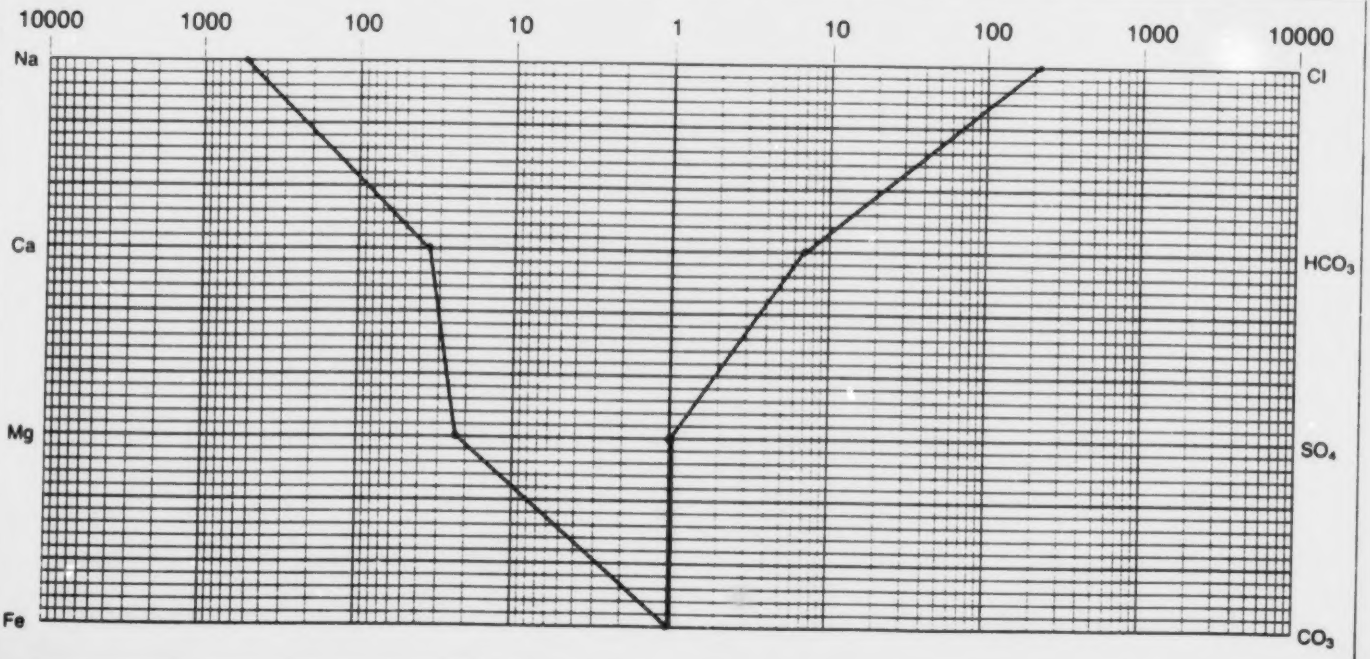
OBSERVED pH @ 22 °C 7.47
DENSITY @ 15°C, g/ml 1.0242
RESISTIVITY @ 25°C, ohm - cm 40
CONDUCTIVITY @ 25°C, μs/cm 24 200.
OIL AND GREASE, mg/L
TOTAL HARDNESS, mg/L 2900.
TOTAL DISSOLVED SOLIDS, mg/L 22 500.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 72.9 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	12 440	541
Ca	705	35
Mg	278	23
Fe	6.23	0
K	260	7
Ba		
Sr		
Mn	0.45	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	8350	235
HCO_3	454	7
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	13	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

(4)

WELL NAME Standard Hill	LOCATION 5-35-49-22	FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 21
DATE SAMPLED YEAR 1988 MONTH 08 DAY 21 SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.08

DENSITY @ 15°C, g/ml 1.0213

RESISTIVITY @ 25°C, ohm - cm 20

CONDUCTIVITY @ 25°C, µs/cm 40 300

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2430.

TOTAL DISSOLVED SOLIDS, mg/L 26 300.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

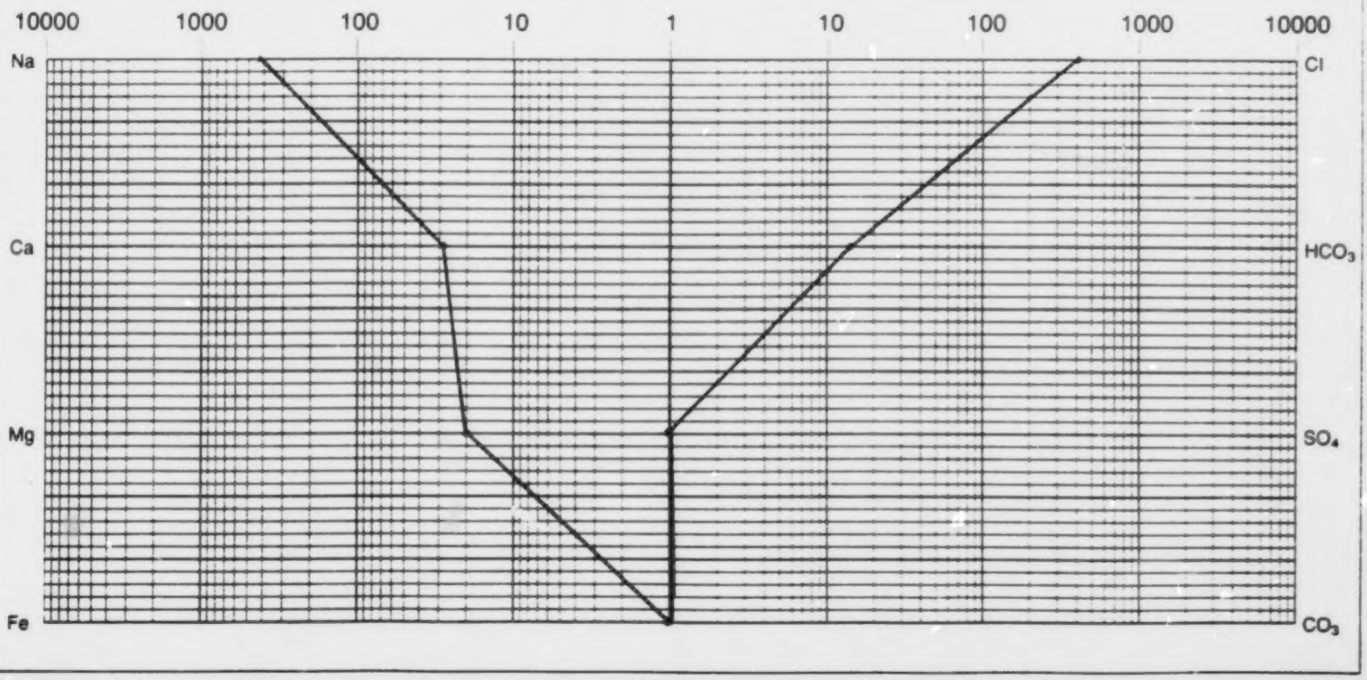
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 65.0 dyne/cm

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Na	9870	429
Ca	567	28
Mg	247	20
Fe	7.02	0
K	240	6
Ba		
Sr		
Mn	0.42	0
Si		

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Cl	14 400	406
HCO_3	902	15
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	23	1
NO_3	ND	0
PO4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky
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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 5-35-49-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 19
DATE SAMPLED YEAR 1988 MONTH 08 DAY 20	SAMPLED BY	
SAMPLE CONTAINER(S) Plastic		PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.60
DENSITY @ 15°C, g/ml 1.0178
RESISTIVITY @ 25°C, ohm - cm 40
CONDUCTIVITY @ 25°C, μs/cm 26 700.
OIL AND GREASE, mg/L

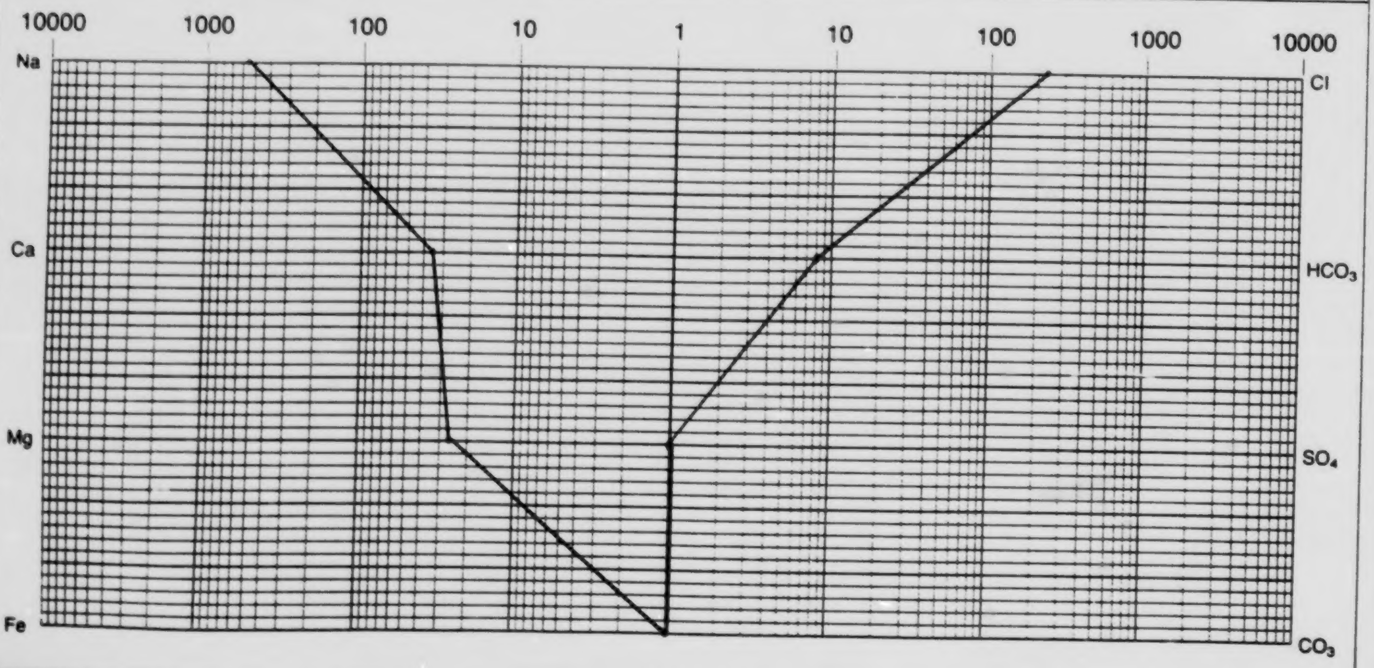
TOTAL HARDNESS, mg/L 3070.
TOTAL DISSOLVED SOLIDS, mg/L 22 900.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 64.4 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	12 850	559
Ca	705	35
Mg	320	26
Fe	9.36	1
K	290	7
Ba		
Sr		
Mn	0.51	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	8230	232
HCO_3	473	8
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	14	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 5-35-49-22		FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman		DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD		DATE YEAR 1988 MONTH 09 DAY 21
DATE SAMPLED YEAR 1988 MONTH 08 DAY 23	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

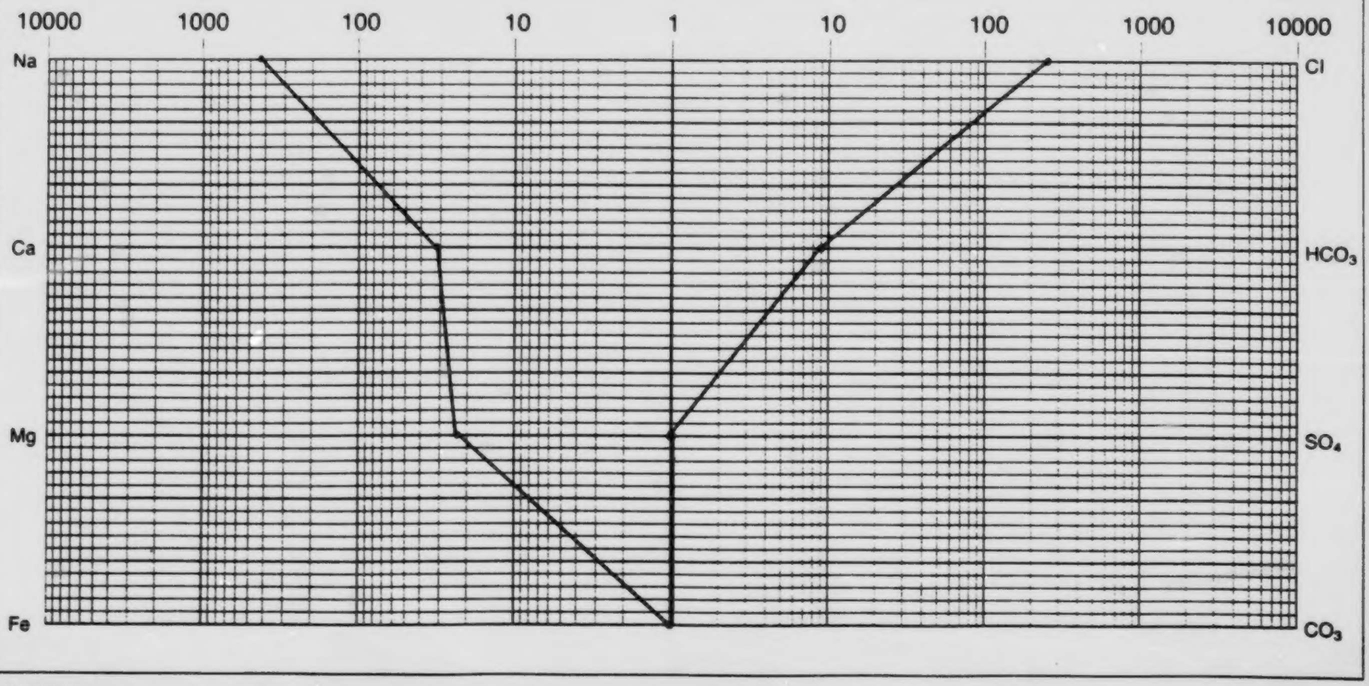
OBSERVED pH @ 22 °C	7.08	TOTAL HARDNESS, mg/L	2720.
DENSITY @ 15°C, g/ml	1.0230	TOTAL DISSOLVED SOLIDS, mg/L	21 200.
RESISTIVITY @ 25°C, ohm - cm	37	TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, μs/cm	27 700	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension - 71.9 dyne/cm

ION	CONCENTRATION mg/L	meq/L
Na	10 070	438
Ca	634	32
Mg	277	23
Fe	7.01	0
K	230	6
Ba		
Sr		
Mn	0.37	0
Si		

ION	CONCENTRATION mg/L	meq/L
Cl	9390	265
HCO_3	576	9
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	16	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky

(5)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A6-35-49-22	FILE REFERENCE NUMBER DV/PDN:045
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 08 DAY 30	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 14
DATE SAMPLED YEAR 1988 MONTH 08 DAY 15 SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) No

OBSERVED pH @ 18.0 °C 5.45

DENSITY @ 15°C, g/ml 1.0330

RESISTIVITY @ 25°C, ohm - cm 27

CONDUCTIVITY @ 25°C, µs/cm 34 900

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2 370

TOTAL DISSOLVED SOLIDS, mg/L 24 600.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

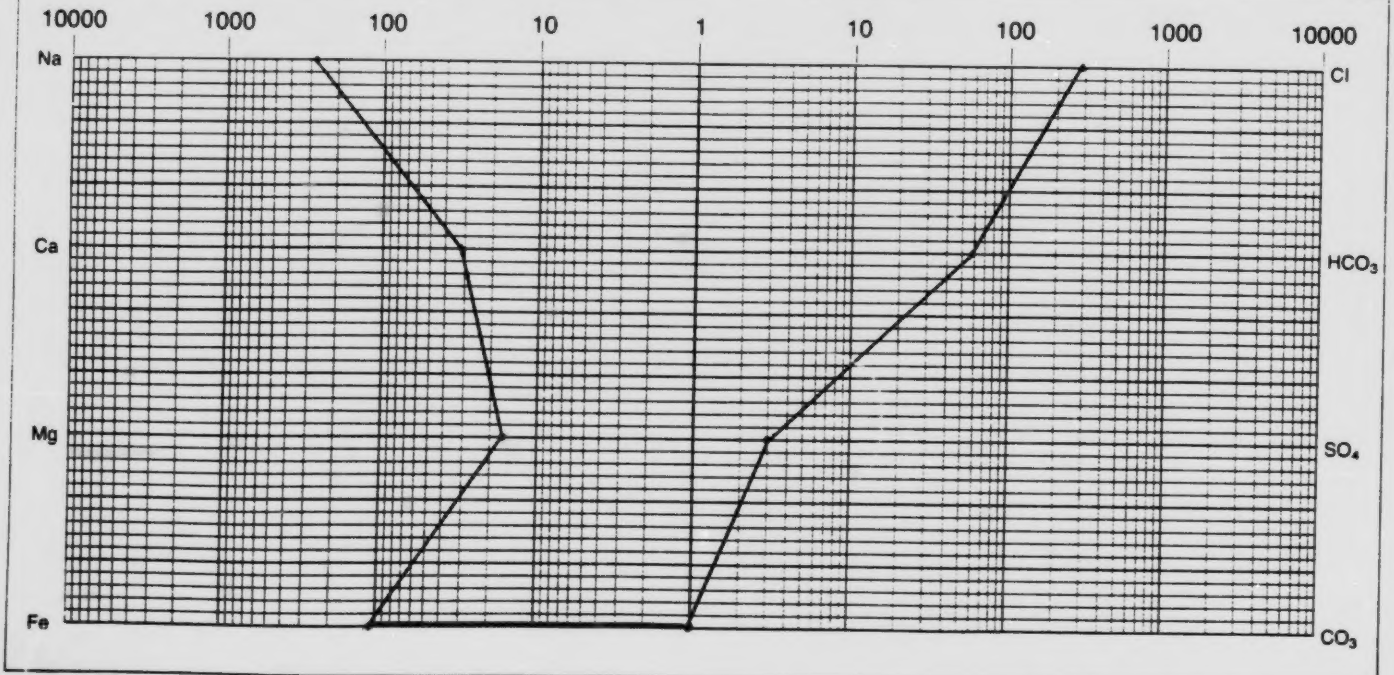
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 58.0 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	6 480	282
Ca	615	31
Mg	204	17
Fe	1 872	101
K	1 430	37
Ba		
Sr		
Mn	16.46	1
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	10 273	290
HCO_3	3 610	59
SO_4	128	3
CO_3	ND	0
OH	ND	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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(13)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A6-35-49-22	FILE REFERENCE NUMBER DV/PDN:045
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 08 DAY 30	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 14
DATE SAMPLED YEAR 1988 MONTH 08 DAY 16	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) No

OBSERVED pH @ 20 °C 7.33
DENSITY @ 15°C, g/ml 1.0181
RESISTIVITY @ 25°C, ohm - cm 27
CONDUCTIVITY @ 25°C, μs/cm 37 100
OIL AND GREASE, mg/L

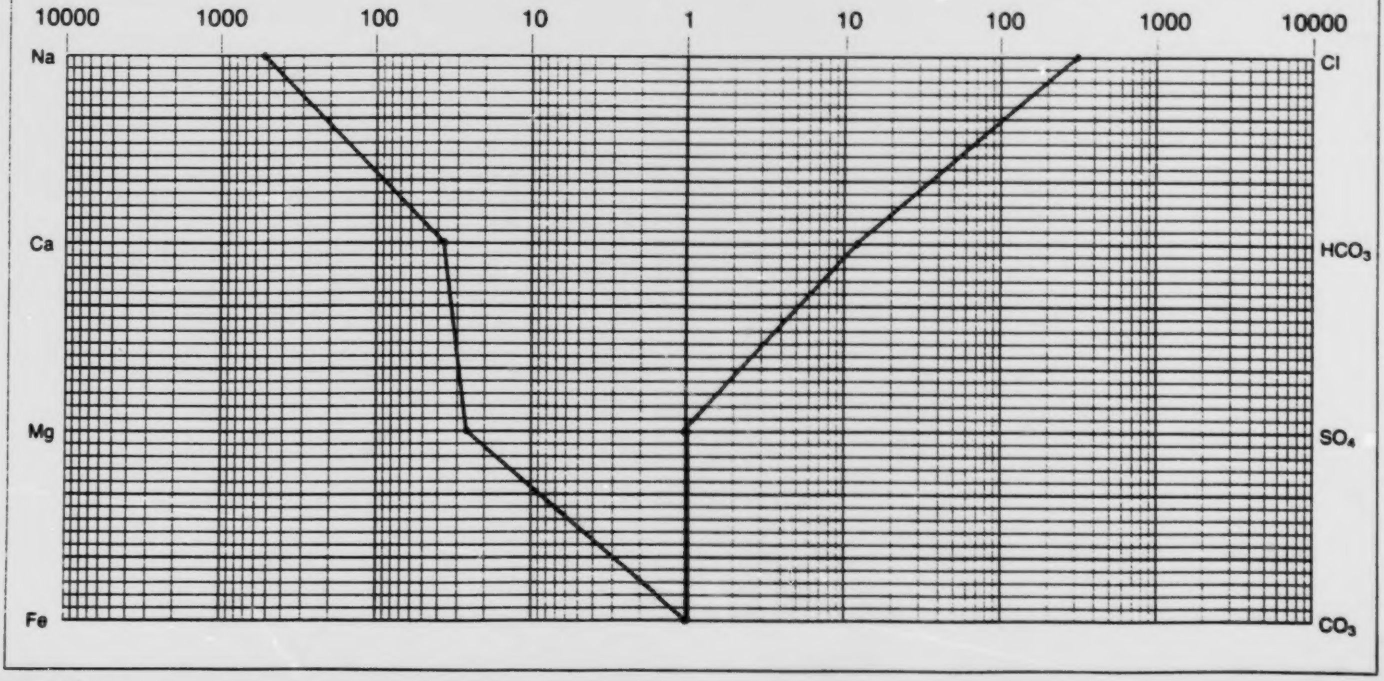
TOTAL HARDNESS, mg/L 3040.
TOTAL DISSOLVED SOLIDS, mg/L 25 700.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 58.0 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	12 220	532
Ca	712	36
Mg	304	26
Fe	26.32	1
K	480	12
Ba		
Sr		
Mn	0.79	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	11 188	316
HCO_3	761	13
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	21	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
(5)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A6-35-49-22	FILE REFERENCE NUMBER DV/PDN:044
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 06	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED YEAR 1988 MONTH 08 DAY 17 SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.44
DENSITY @ 15°C, g/ml 1.0127
RESISTIVITY @ 25°C, ohm - cm 36
CONDUCTIVITY @ 25°C, μs/cm 27 600.
OIL AND GREASE, mg/L

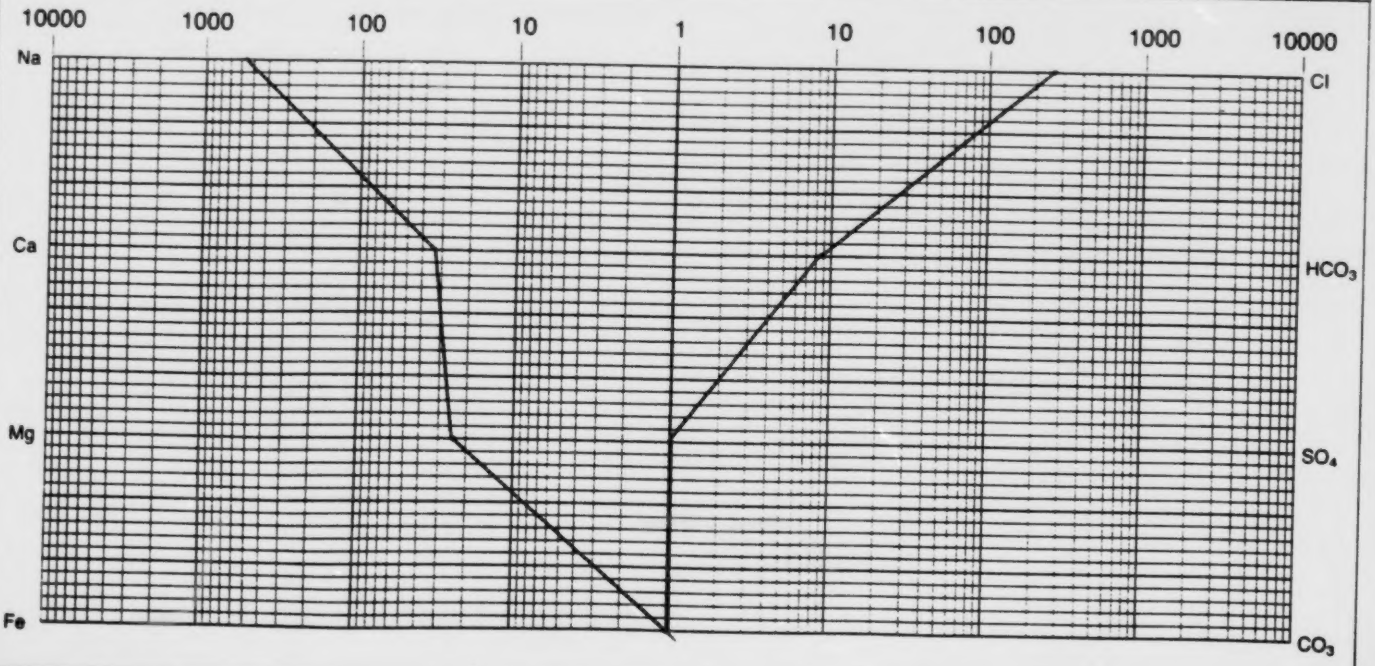
TOTAL HARDNESS, mg/L 2880.
TOTAL DISSOLVED SOLIDS, mg/L 24 800.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 70.9 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	12 950	563
Ca	667	33
Mg	294	24
Fe	18.67	1
K	311	8
Ba		
Sr		
Mn	0.75	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	10 013	282
HCO_3	556	9
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	14	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
(13)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A6-35-49-22	FILE REFERENCE NUMBER DV/PDN:044
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 06	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED YEAR 1988 MONTH 08 DAY 18	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.33
DENSITY @ 15°C, g/ml 1.0103
RESISTIVITY @ 25°C, ohm - cm 43
CONDUCTIVITY @ 25°C, µs/cm 23 500.
OIL AND GREASE, mg/L

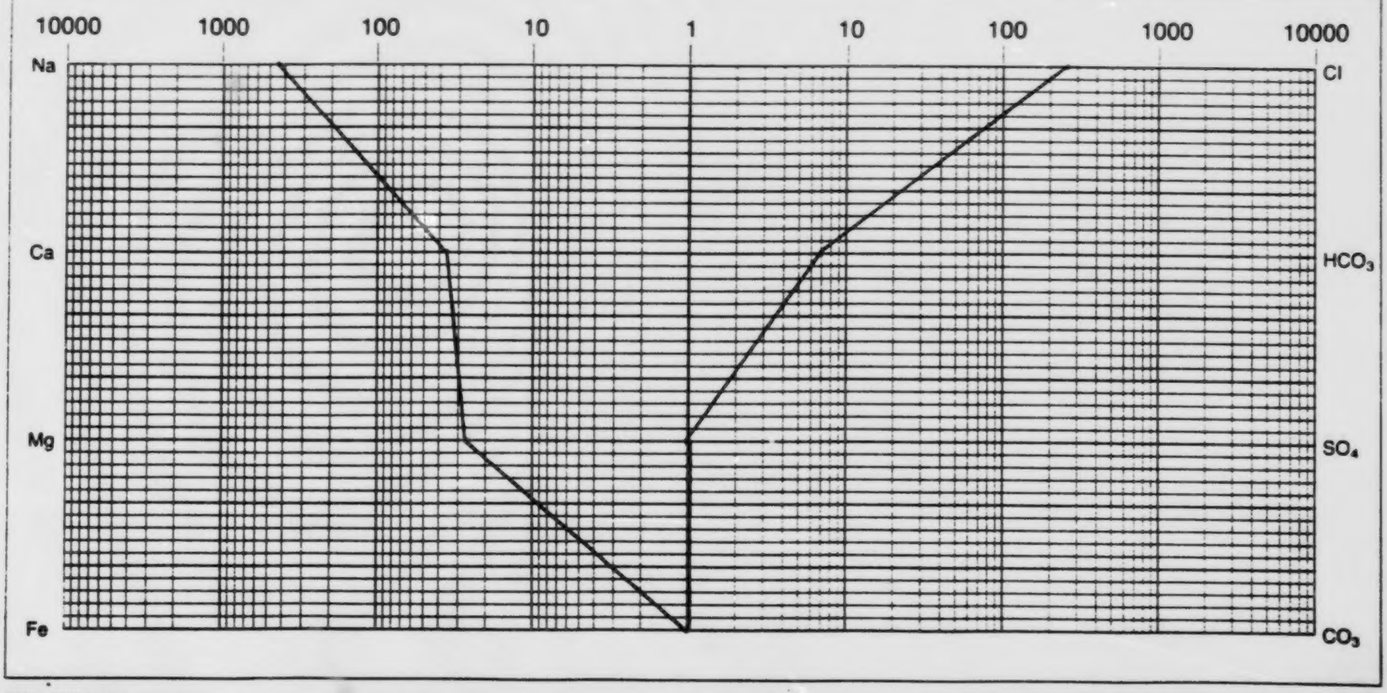
TOTAL HARDNESS, mg/L 3130.
TOTAL DISSOLVED SOLIDS, mg/L 21 900.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 71.5 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 320	449
Ca	731	36
Mg	318	26
Fe	10.03	1
K	326	8
Ba		
Sr		
Mn	0.61	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	9696	273
HCO_3	439	7
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	12	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky
(6)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME: Standard Hill
LOCATION: A6-35-49-22
FILE REFERENCE NUMBER: DV/PDN:049
ANALYST: I. Nowak/A. Rehman
DATE ANALYSED: YEAR 1988 MONTH 09 DAY 12
LAB SAMPLE NUMBER:
FORMATION:
FIELD:
DATE: YEAR 1988 MONTH 09 DAY 19
DATE SAMPLED: YEAR 1988 MONTH 08 DAY 19
SAMPLED BY:
SAMPLE CONTAINER(S): Plastic
PRESERVATIVE(S): None

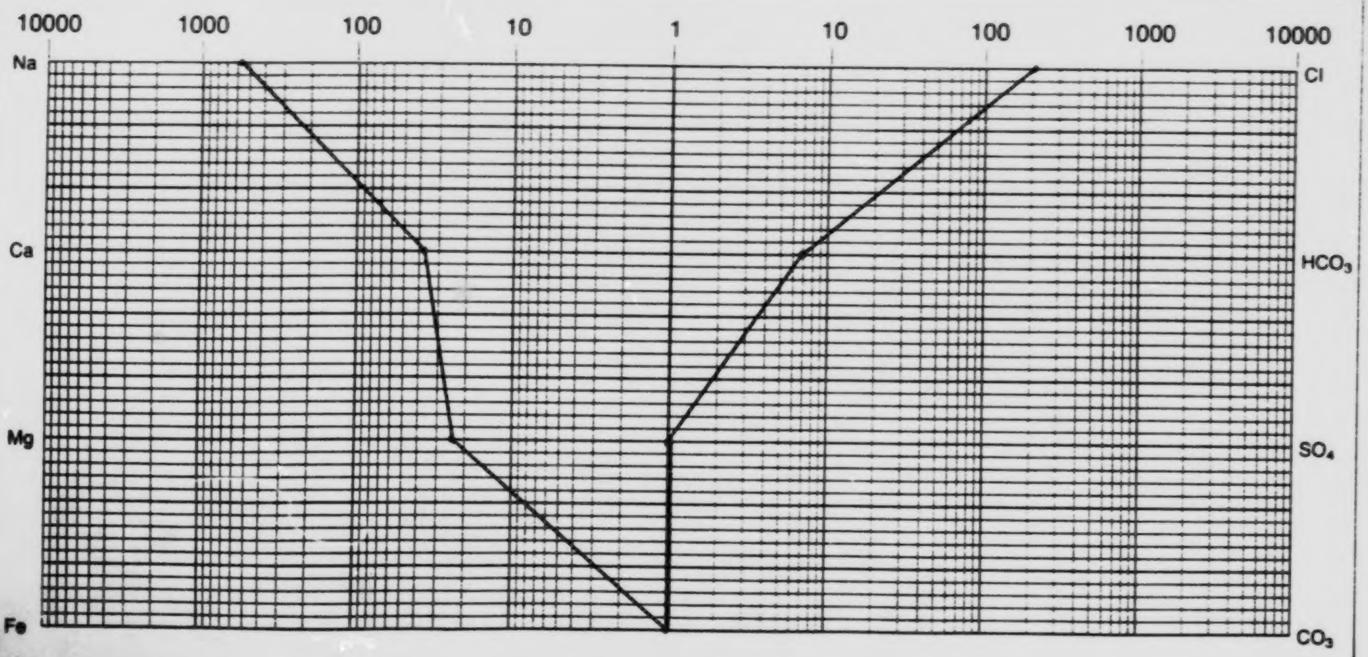
OBSERVED pH @ 22 °C: 7.42
DENSITY @ 15°C, g/ml: 1.0239
RESISTIVITY @ 25°C, ohm - cm: 45
CONDUCTIVITY @ 25°C, μs/cm: 20 900
OIL AND GREASE, mg/L:
TOTAL HARDNESS, mg/L: 3130.
TOTAL DISSOLVED SOLIDS, mg/L: 22 400.
TOTAL SUSPENDED SOLIDS, mg/L:
VOLATILE SUSPENDED SOLIDS, mg/L:
FIXED SUSPENDED SOLIDS, mg/L:

Surface Tension - 70.5 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	13 390	582
Ca	766	38
Mg	296	24
Fe	19.87	1
K	290	7
Ba		
Sr		
Mn	0.69	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	7160	202
HCO_3	420	7
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	12	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky
(17)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill
LOCATION 6-35-49-22
FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman
DATE ANALYSED YEAR 1988 MONTH 09 DAY 12
LAB SAMPLE NUMBER
FORMATION
FIELD
DATE YEAR 1988 MONTH 09 DAY 19
DATE SAMPLED YEAR 1988 MONTH 08 DAY 20
SAMPLED BY
SAMPLE CONTAINER(S) Plastic
PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.29
DENSITY @ 15°C, g/ml 1.0219
RESISTIVITY @ 25°C, ohm - cm 33
CONDUCTIVITY @ 25°C, µs/cm 30 300.
OIL AND GREASE, mg/L

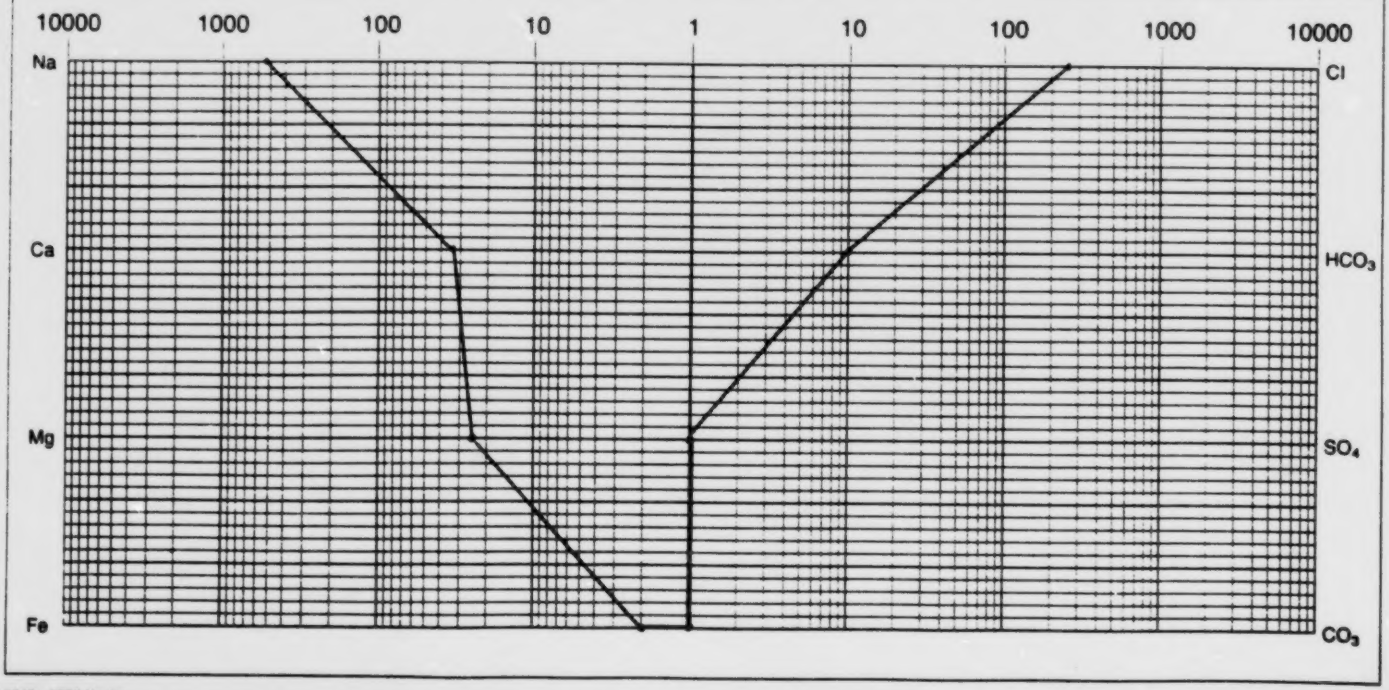
TOTAL HARDNESS, mg/L 2910.
TOTAL DISSOLVED SOLIDS, mg/L 23 600.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 62.5 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	12 220	532
Ca	672	34
Mg	300	25
Fe	29.50	2
K	280	7
Ba		
Sr		
Mn	0.84	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	9490	268
HCO_3	580	10
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	16	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky
(5)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME: Standard Hill
LOCATION: 6-35-49-22
FILE REFERENCE NUMBER: DV/PDN:053
ANALYST: I. Nowak/A. Rehman
DATE ANALYSED: YEAR 1988 | MONTH 09 | DAY 16
LAB SAMPLE NUMBER:
FORMATION:
FIELD:
DATE: YEAR 1988 | MONTH 09 | DAY 21
DATE SAMPLED: YEAR 1988 | MONTH 08 | DAY 21
SAMPLED BY:
SAMPLE CONTAINER(S): Plastic
PRESERVATIVE(S): None

OBSERVED pH @ 22 °C: 7.29
DENSITY @ 15°C, g/ml: 1.0225
RESISTIVITY @ 25°C, ohm - cm: 34
CONDUCTIVITY @ 25°C, µs/cm: 33 200
OIL AND GREASE, mg/L:

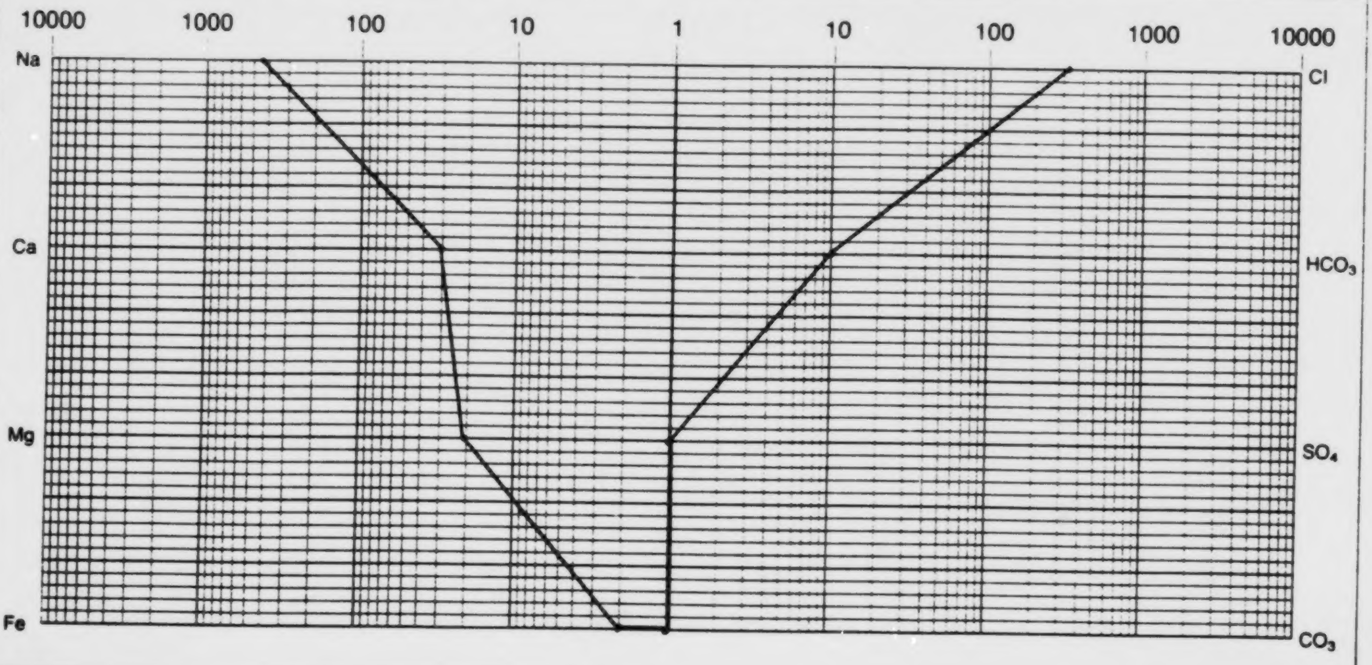
TOTAL HARDNESS, mg/L: 2560.
TOTAL DISSOLVED SOLIDS, mg/L: 23 700.
TOTAL SUSPENDED SOLIDS, mg/L:
VOLATILE SUSPENDED SOLIDS, mg/L:
FIXED SUSPENDED SOLIDS, mg/L:

Surface Tension - 66.4 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 280	447
Ca	595	30
Mg	261	21
Fe	28.34	2
K	190	5
Ba		
Sr		
Mn	0.75	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	11 700	330
HCO_3	620	10
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	18	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky

HEAVY OIL LABORATORY WATER ANALYSIS

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WELL NAME Standard Hill	LOCATION 6-35-49-22		FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman		DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD		DATE YEAR 1988 MONTH 09 DAY 21
DATE SAMPLED YEAR 1988 MONTH 08 DAY 23	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

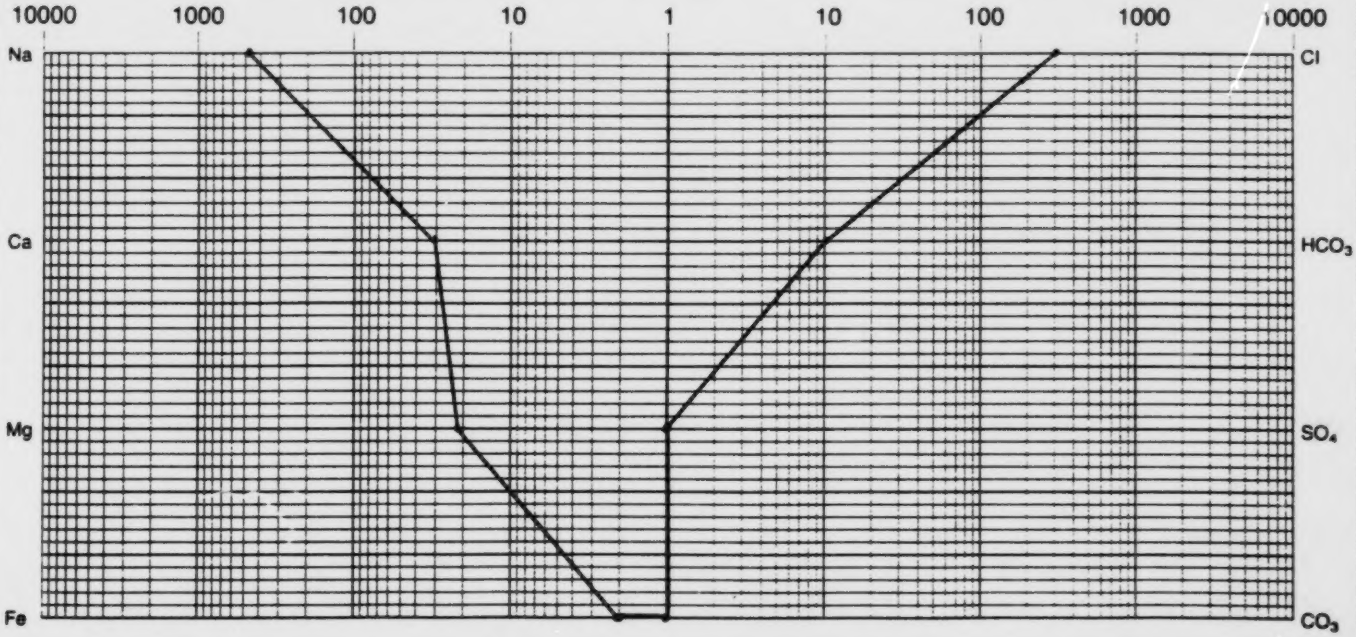
OBSERVED pH @ 22 °C	7.00	TOTAL HARDNESS, mg/L	2640.
DENSITY @ 15°C, g/ml	1.0227	TOTAL DISSOLVED SOLIDS, mg/L	23 700.
RESISTIVITY @ 25°C, ohm - cm	29	TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, μs/cm	34 600	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension - 64.9 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 190	487
Ca	621	31
Mg	265	22
Fe	30.56	2
K	220	6
Ba		
Sr		
Mn	0.63	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	10 700	302
HCO_3	663	11
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	18	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
(8)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill		LOCATION A11-35-49-22		FILE REFERENCE NUMBER DV/PDN:045
ANALYST I. Nowak/A. Rehman		DATE ANALYSED YEAR 1988 MONTH 08 DAY 30		LAB SAMPLE NUMBER
FORMATION		FIELD		DATE YEAR 1988 MONTH 09 DAY 14
DATE SAMPLED YEAR 1988 MONTH 08 DAY 15	SAMPLED BY	SAMPLE CONTAINER(S) Plastic		PRESERVATIVE(S) No

OBSERVED pH @ 20 °C 8.38
DENSITY @ 15°C, g/ml 1.0210
RESISTIVITY @ 25°C, ohm - cm 22
CONDUCTIVITY @ 25°C, µs/cm 42 200.
OIL AND GREASE, mg/L

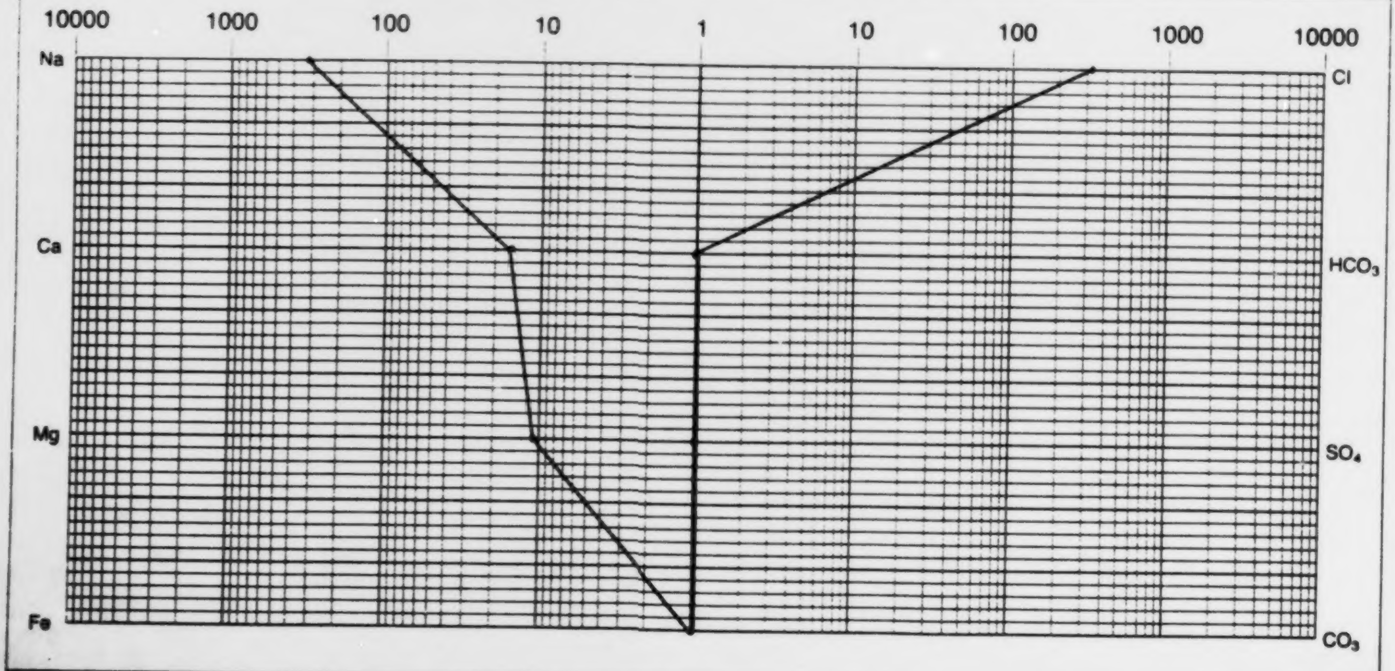
TOTAL HARDNESS, mg/L 1360.
TOTAL DISSOLVED SOLIDS, mg/L 20 400.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 61.9 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	7 440	324
Ca	314	16
Mg	140	12
Fe	4.14	0
K	430	11
Ba		
Sr		
Mn	0.32	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	11 985	338
HCO_3	78	1
SO_4	2	0
CO_3	24	1
OH	ND	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



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Husky
(17)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A11-35-49-22		FILE REFERENCE NUMBER DV/PDN:044
ANALYST I. Nowak/A. Rehman		DATE ANALYSED YEAR 1988 MONTH 09 DAY 06	LAB SAMPLE NUMBER
FORMATION	FIELD		DATE YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED YEAR 1988 MONTH 08 DAY 18	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) No

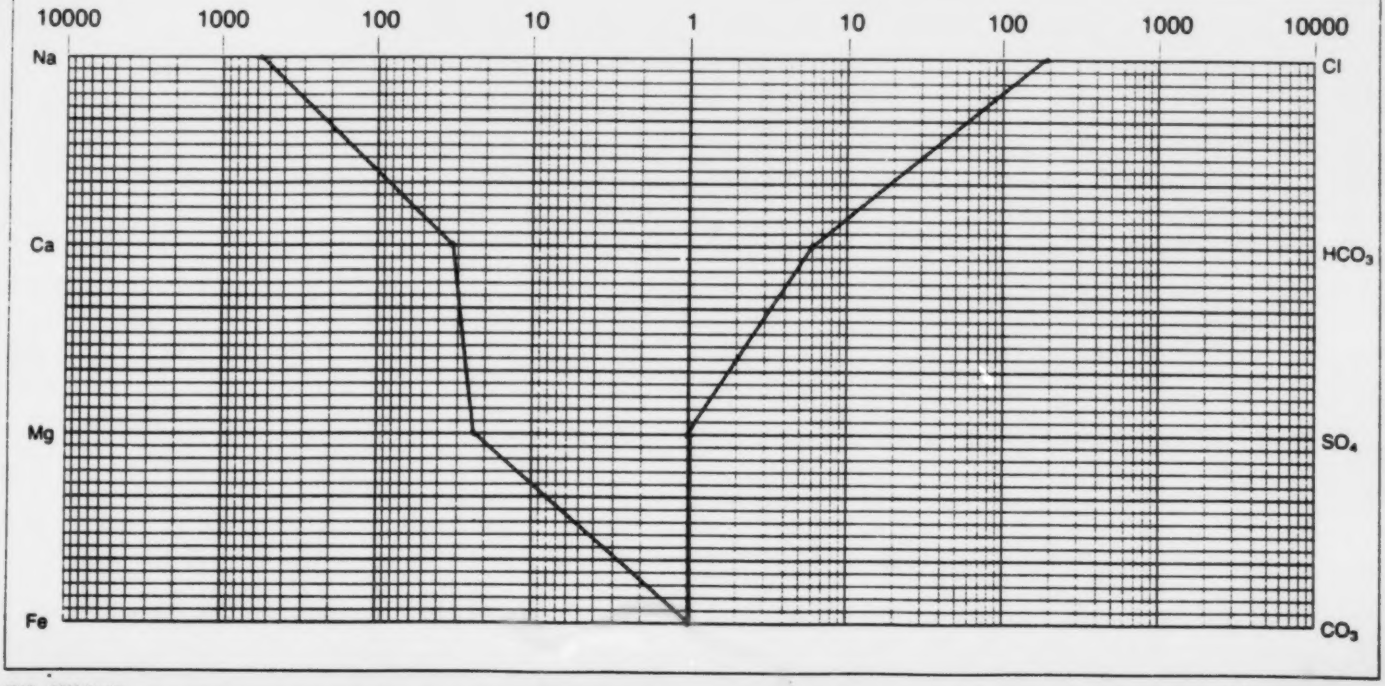
OBSERVED pH @ 23 °C	7.49	TOTAL HARDNESS, mg/L	2880.
DENSITY @ 15°C, g/ml	1.0093	TOTAL DISSOLVED SOLIDS, mg/L	21 900.
RESISTIVITY @ 25°C, ohm - cm	48	TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, μs/cm	21 900.	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension - 70.0 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	13 500	587
Ca	668	33
Mg	294	24
Fe	6.70	0
K	297.6	8
Ba		
Sr		
Mn	0.54	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	6728	190
HCO_3	376	6
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	11	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky
(10)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A11-35-49-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988, MONTH 09, DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988, MONTH 09, DAY 19
DATE SAMPLED YEAR 1988, MONTH 08, DAY 19	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.59
DENSITY @ 15°C, g/ml 1.0216
RESISTIVITY @ 25°C, ohm - cm 29
CONDUCTIVITY @ 25°C, μs/cm 30 100
OIL AND GREASE, mg/L

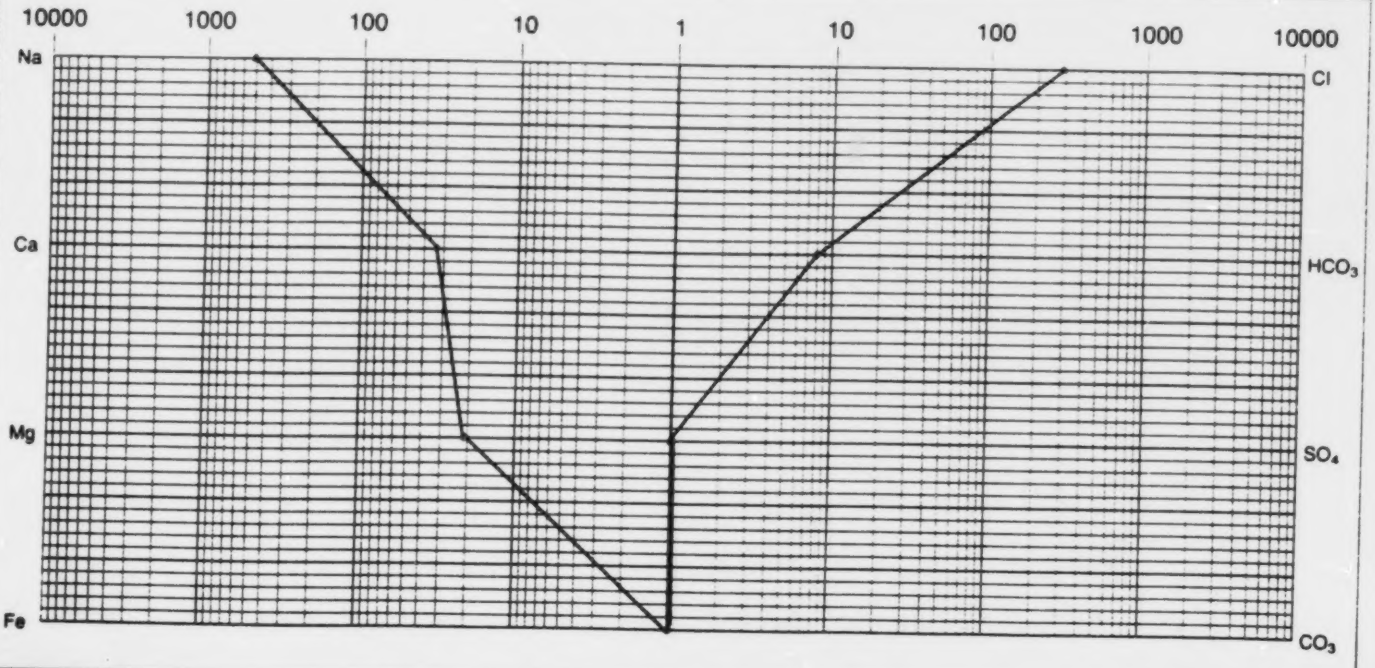
TOTAL HARDNESS, mg/L 2750.
TOTAL DISSOLVED SOLIDS, mg/L 23 600.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 72.0 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 570	503
Ca	678	34
Mg	258	21
Fe	10.04	1
K	240	6
Ba		
Sr		
Mn	0.59	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	10 350	292
HCO_3	512	8
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	17	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
(21)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 11-35-49-22		FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman		DATE ANALYSED YEAR 1988, MONTH 09, DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD		DATE YEAR 1988, MONTH 09, DAY 19
DATE SAMPLED YEAR 1988, MONTH 08, DAY 20	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

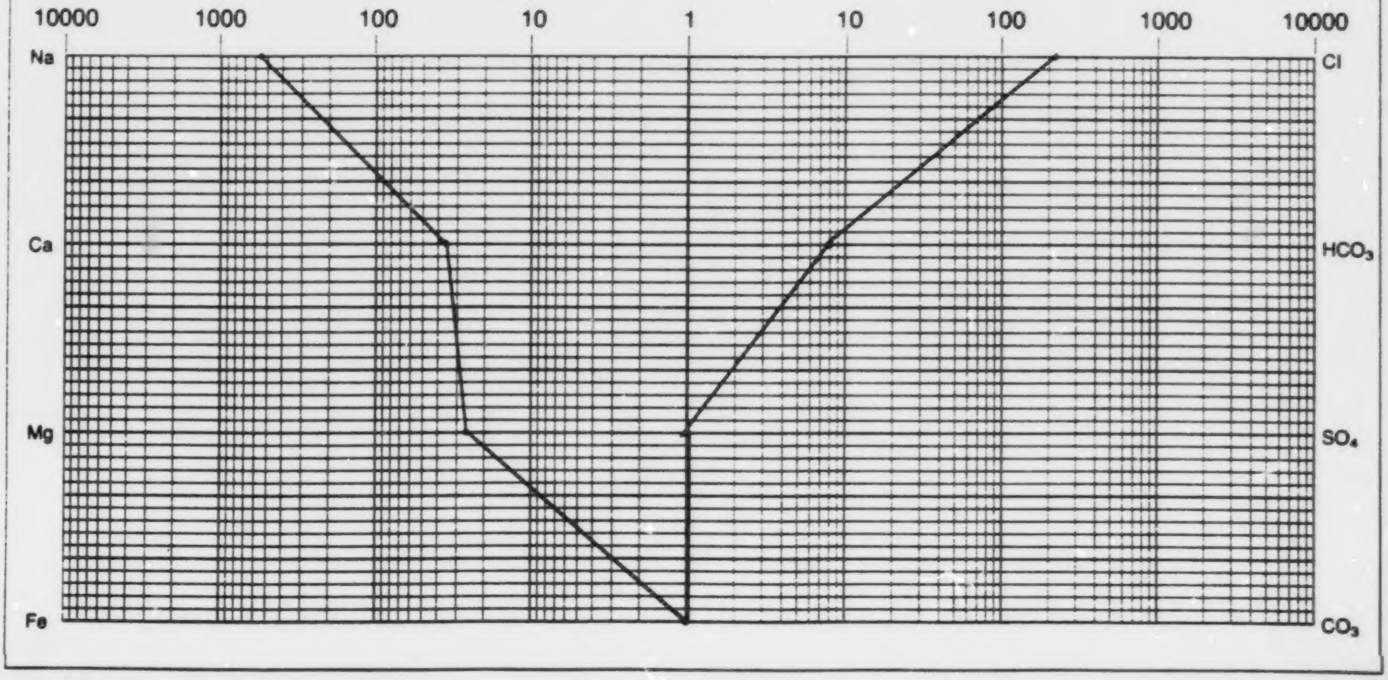
OBSERVED pH @ 22 °C	7.36	TOTAL HARDNESS, mg/L	3110.
DENSITY @ 15°C, g/ml	1.0175	TOTAL DISSOLVED SOLIDS, mg/L	22 800.
RESISTIVITY @ 25°C, ohm - cm	46	TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, μs/cm	24 400	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension - 62.8 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	12 950	563
Ca	720	36
Mg	320	26
Fe	7.87	0
K	300	8
Ba		
Sr		
Mn	0.54	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	7960	224
HCO_3	488	8
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	14	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky
(9)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 11-35-49-22	FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 21
DATE SAMPLED YEAR 1988 MONTH 08 DAY 21	SAMPLED BY	
	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

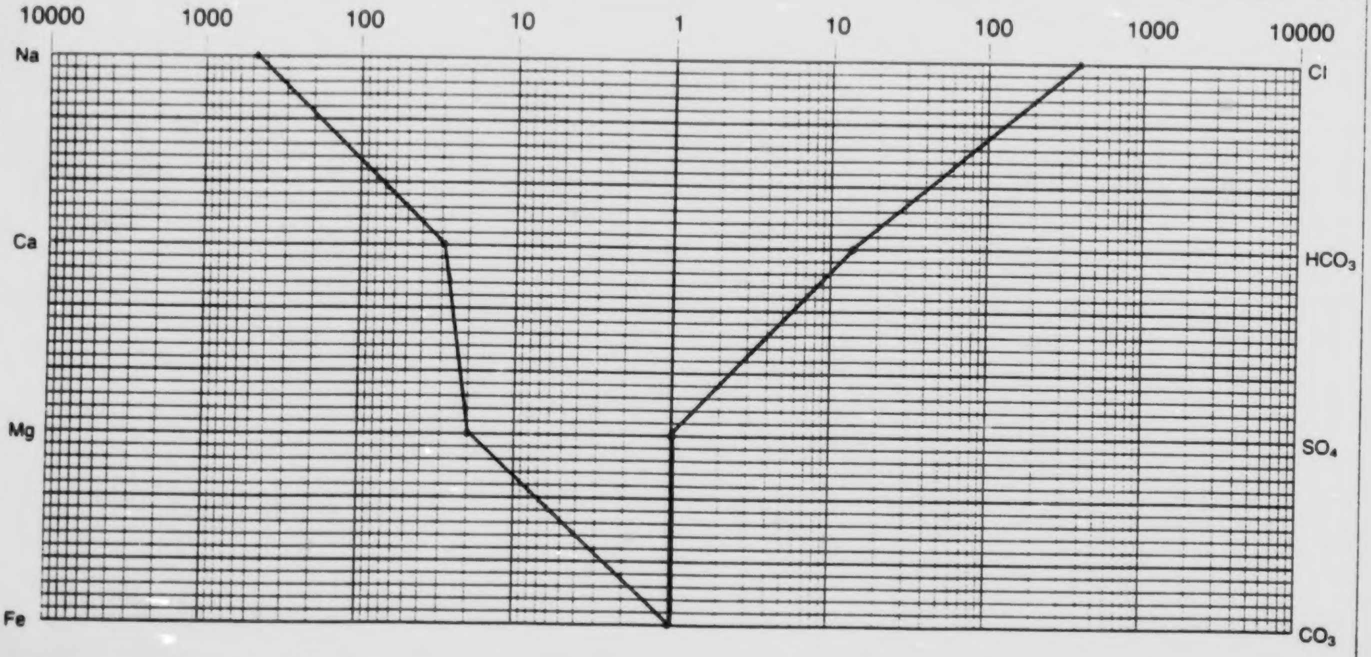
OBSERVED pH @ 22 °C	7.12	TOTAL HARDNESS, mg/L	2430
DENSITY @ 15°C, g/ml	1.0211	TOTAL DISSOLVED SOLIDS, mg/L	26 900
RESISTIVITY @ 25°C, ohm - cm	20	TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, µs/cm	46 600	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension - 65.5 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 040	480
Ca	576	29
Mg	241	20
Fe	7.47	0
K	210	5
Ba		
Sr		
Mn	0.44	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	13 900	392
HCO_3	902	15
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	23	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



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Husky
(19)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 11-35-49-22	FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988, MONTH 09, DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988, MONTH 09, DAY 21
DATE SAMPLED YEAR 1988, MONTH 08, DAY 23 SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 6.97
DENSITY @ 15°C, g/ml 1.0204
RESISTIVITY @ 25°C, ohm - cm 47
CONDUCTIVITY @ 25°C, μs/cm 24 100
OIL AND GREASE, mg/L

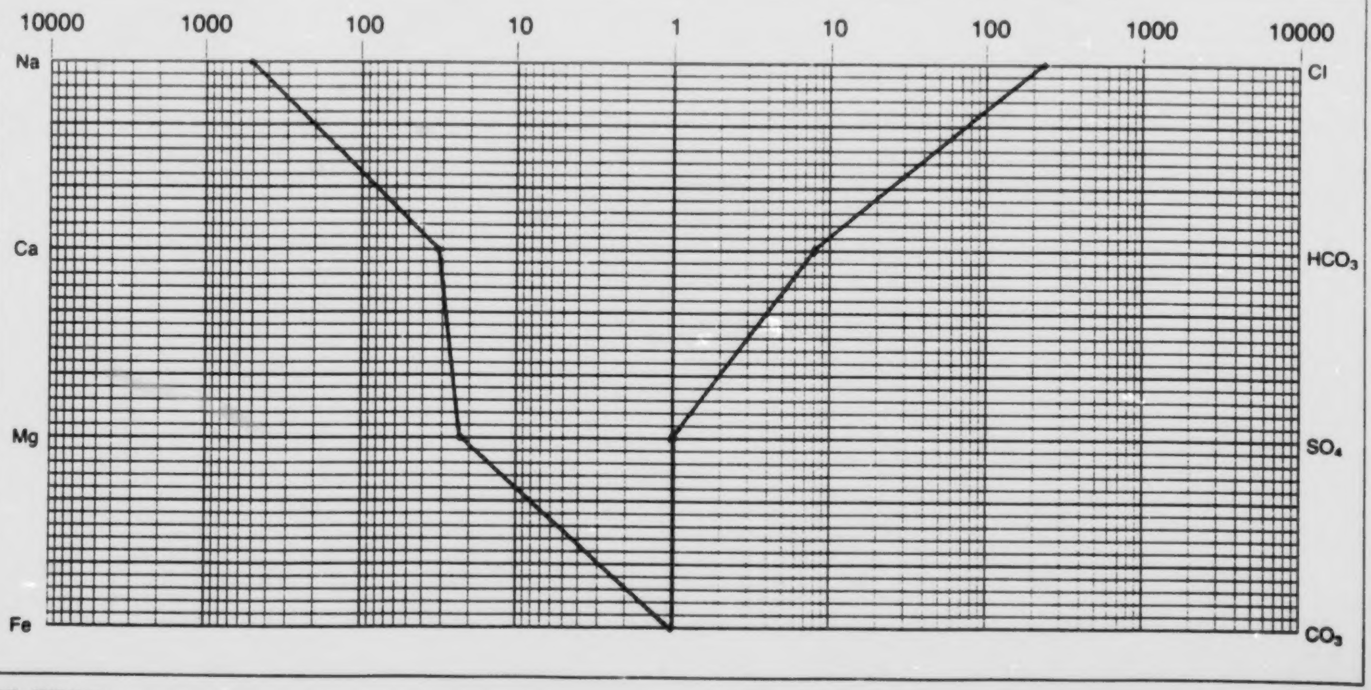
TOTAL HARDNESS, mg/L 2780.
TOTAL DISSOLVED SOLIDS, mg/L 22 100
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 71.7 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 810	514
Ca	650	32
Mg	282	23
Fe	6.76	0
K	240	6
Ba		
Sr		
Mn	0.40	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	8630	243
HCO_3	498	8
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	13	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky
(9)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A12-35-49-22	FILE REFERENCE NUMBER DV/PDN:045
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 08 DAY 30	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 14
DATE SAMPLED YEAR 1988 MONTH 08 DAY 15	SAMPLED BY	
	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) No

OBSERVED pH @ 20 °C 6.69
DENSITY @ 15°C, g/ml 1.0371
RESISTIVITY @ 25°C, ohm - cm 14
CONDUCTIVITY @ 25°C, μs/cm 66 200
OIL AND GREASE, mg/L

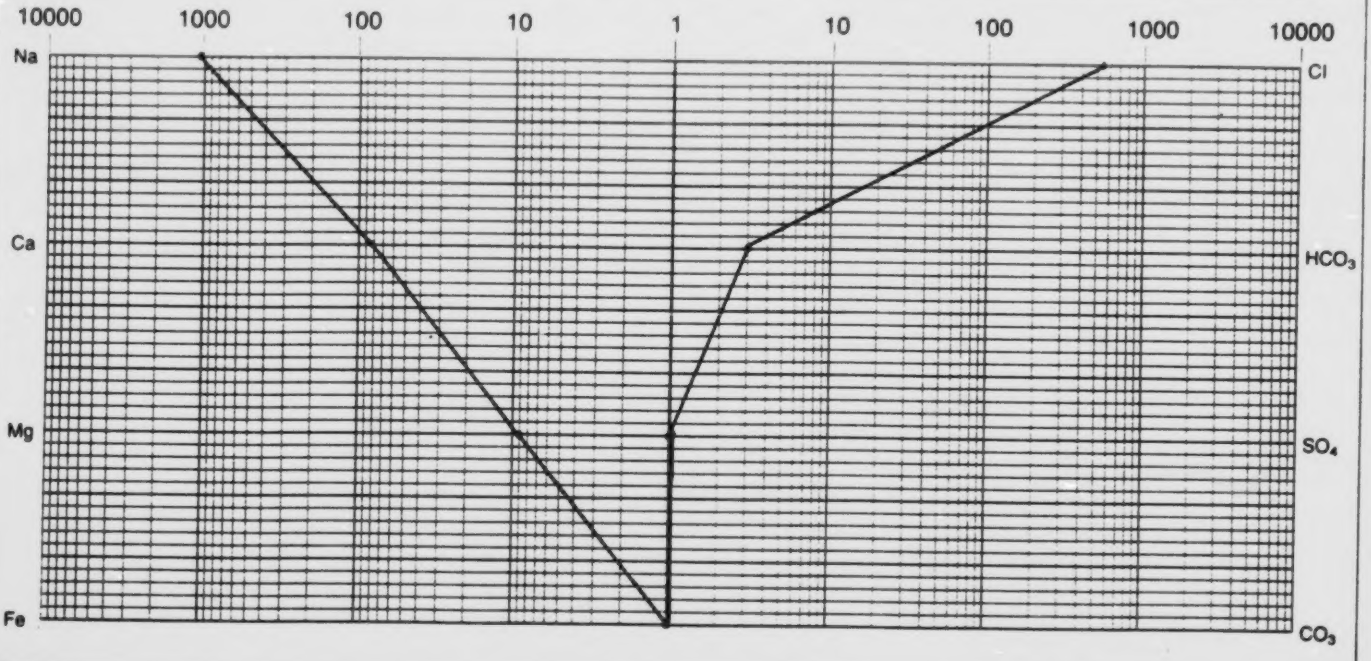
TOTAL HARDNESS, mg/L 4520
TOTAL DISSOLVED SOLIDS, mg/L 49 800
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 71.5 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	27 300	1188
Ca	1 638	82
Mg	104	9
Fe	25.32	1
K	840	22
Ba		
Sr		
Mn	0.65	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	19 707	556
HCO_3	156	3
SO_4	ND	0
CO_3	0	0
OH	0	0
NO_3	ND	0
PO_4	ND	0
F	33	2

LOGARITHMIC WATER PATTERN (meg/L)



0343 - 8509

Husky
(11)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A12-35-49-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR MONTH DAY 1988, 09, 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR MONTH DAY 1988, 09, 19

DATE SAMPLED YEAR MONTH DAY 1988, 08, 19	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

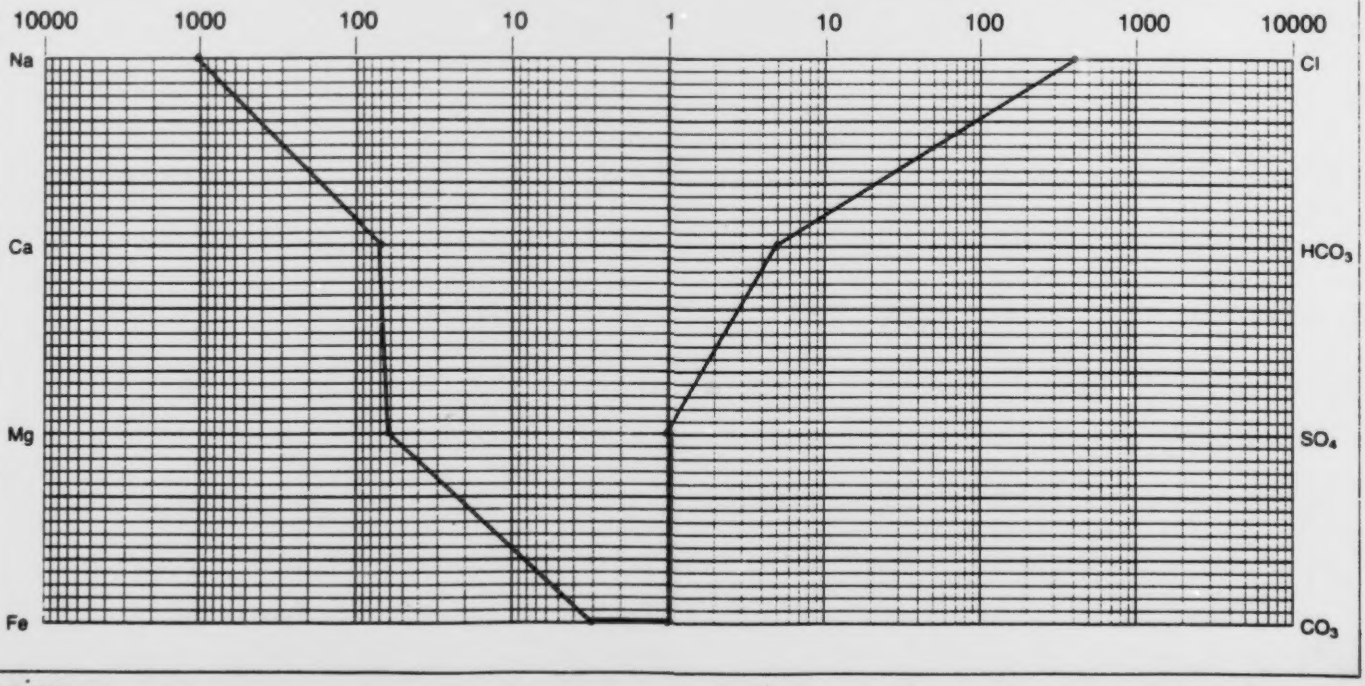
OBSERVED pH @ 22 °C	7.01	TOTAL HARDNESS, mg/L	6670.
DENSITY @ 15°C, g/ml	1.0444	TOTAL DISSOLVED SOLIDS, mg/L	40 600.
RESISTIVITY @ 25°C, ohm - cm	26	TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, μs/cm	40 400	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension - 65.9 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	23 100	1005
Ca	1390	69
Mg	780	64
Fe	62.16	3
K	510	13
Ba		
Sr		
Mn	0.75	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	14 400	406
HCO_3	293	5
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	22	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky
(22)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 12-35-49-21	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 19
DATE SAMPLED YEAR 1988 MONTH 08 DAY 20 SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 6.88

DENSITY @ 15°C, g/ml 1.0268

RESISTIVITY @ 25°C, ohm - cm 29

CONDUCTIVITY @ 25°C, µs/cm 34 700.

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 6060.

TOTAL DISSOLVED SOLIDS, mg/L 33700

TOTAL SUSPENDED SOLIDS, mg/L

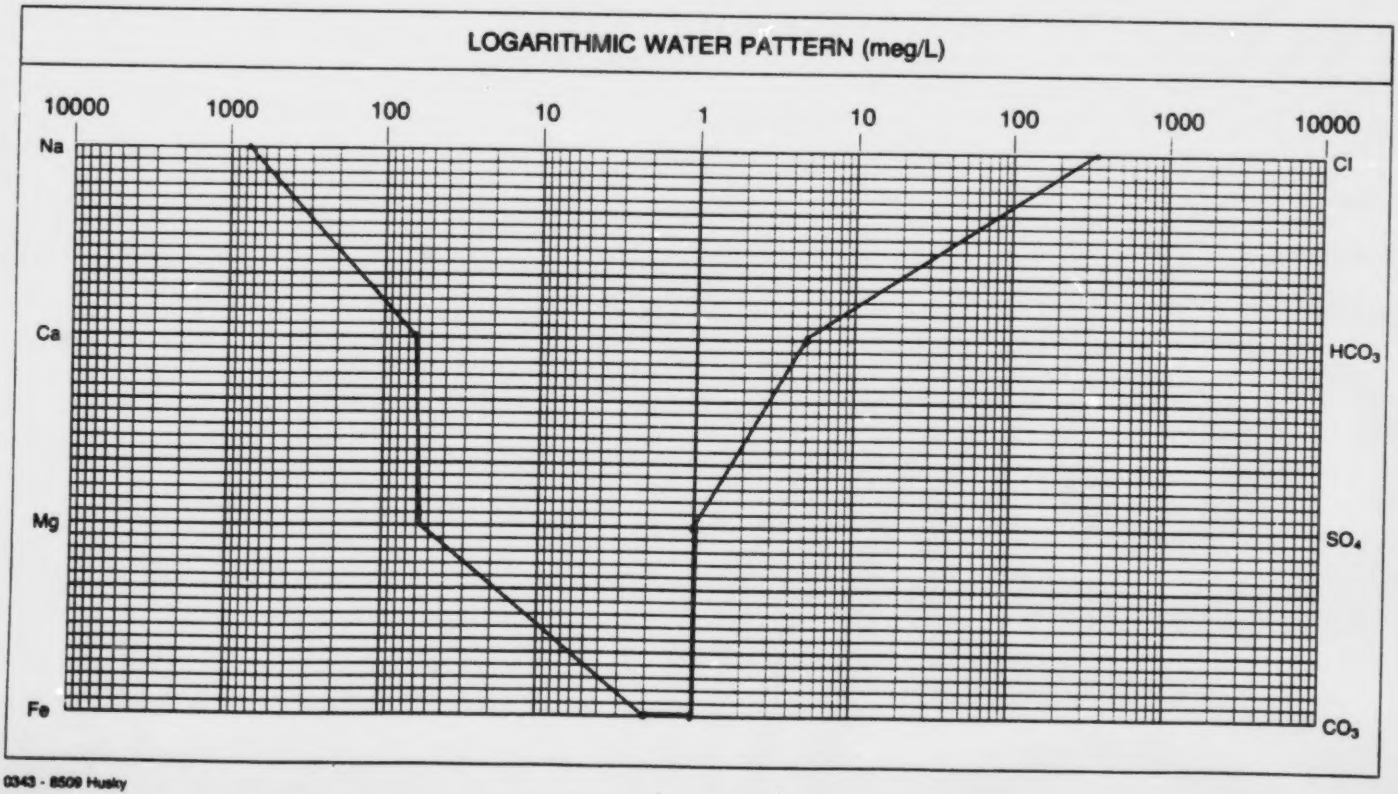
VOLATILE SUSPENDED SOLIDS, mg/L

FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 64.7 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	18 190	791
Ca	1260	63
Mg	710	58
Fe	29.61	2
K	500	13
Ba		
Sr		
Mn	0.69	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	12 710	358
HCO_3	322	5
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	20	1
NO_3	ND	0
PO_4	ND	0


LOGARITHMIC WATER PATTERN (meg/L)

Husky
(10)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 12-35-49-22	FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 21

DATE SAMPLED YEAR 1988 MONTH 08 DAY 21	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 6.73
DENSITY @ 15°C, g/ml 1.0212
RESISTIVITY @ 25°C, ohm - cm 20
CONDUCTIVITY @ 25°C, µs/cm 45 700
OIL AND GREASE, mg/L

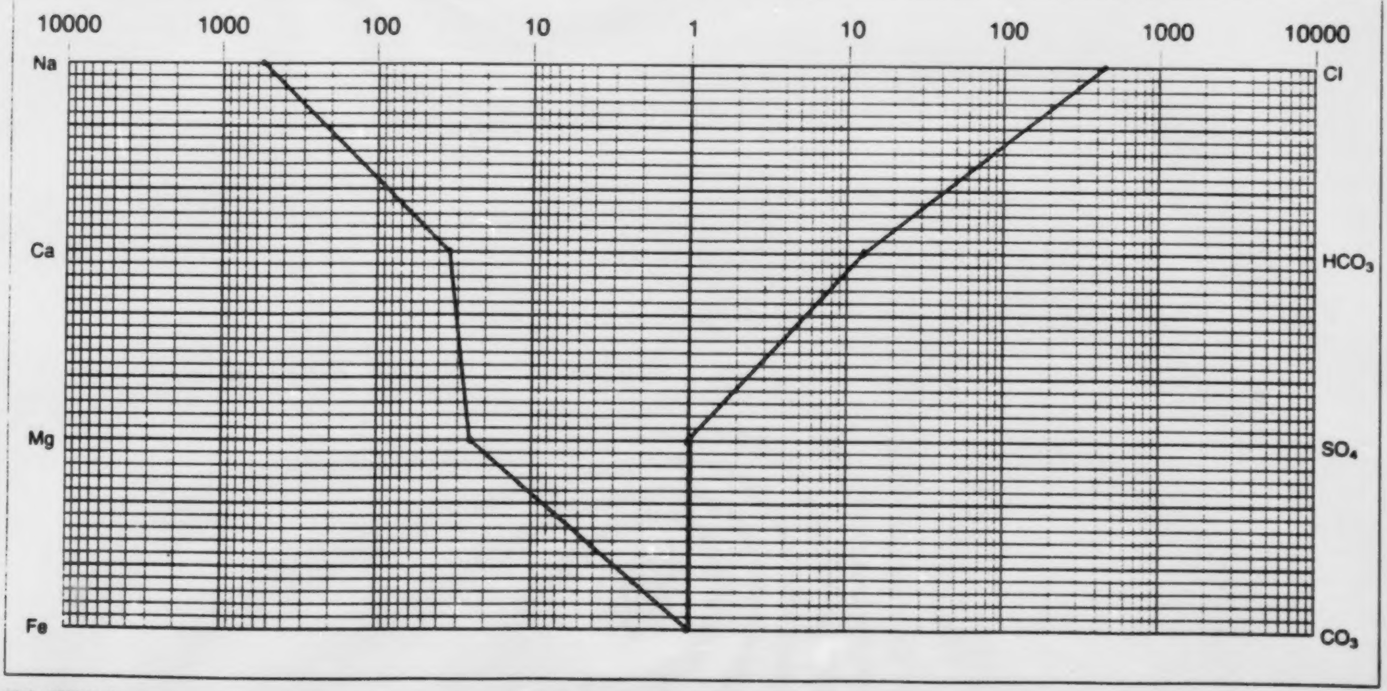
TOTAL HARDNESS, mg/L 2940.
TOTAL DISSOLVED SOLIDS, mg/L 30 500.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 65.5 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	12 640	550
Ca	675	34
Mg	306	25
Fe	26.75	1
K	250	6
Ba		
Sr		
Mn	0.53	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	15 800	446
HCO_3	829	14
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	ND	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 12-35-49-22	FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 21
DATE SAMPLED YEAR 1988 MONTH 08 DAY 23	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 6.88
DENSITY @ 15°C, g/ml 1.0227
RESISTIVITY @ 25°C, ohm - cm 23
CONDUCTIVITY @ 25°C, µs/cm 39 800
OIL AND GREASE, mg/L

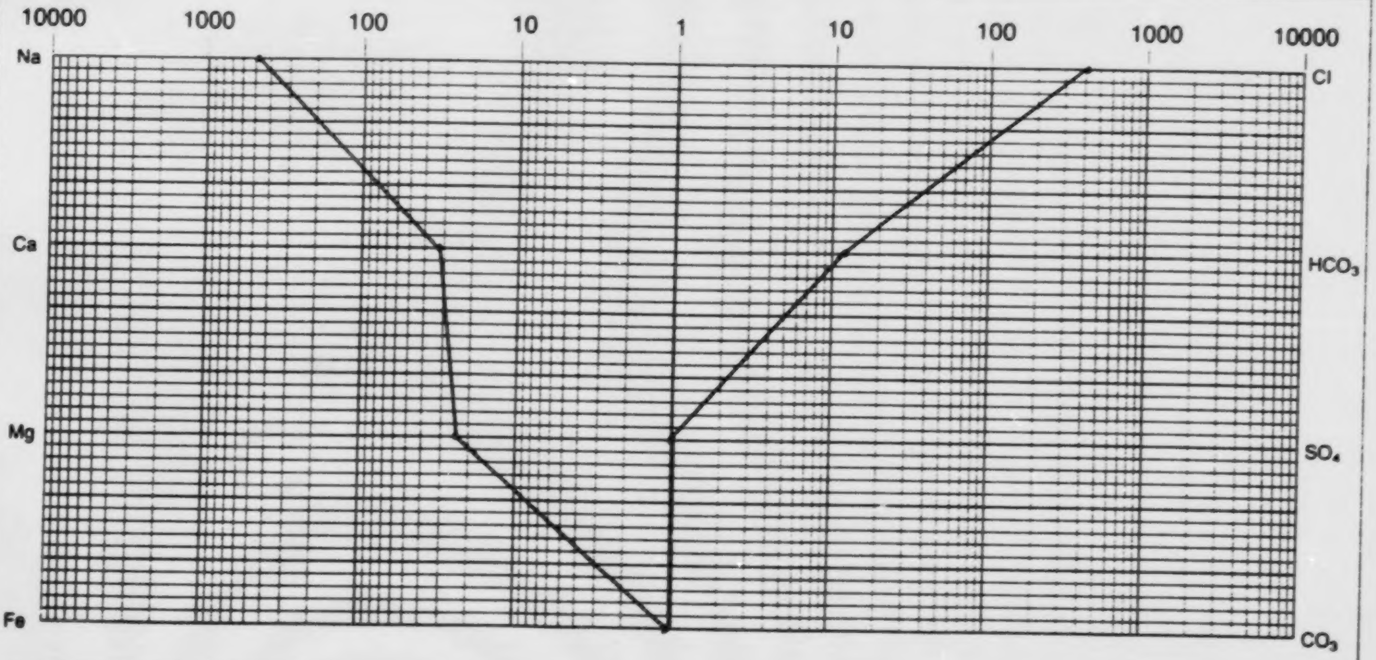
TOTAL HARDNESS, mg/L 2770.
TOTAL DISSOLVED SOLIDS, mg/L 28 300
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 71.2 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 270	490
Ca	639	32
Mg	287	24
Fe	14.17	1
K	240	6
Ba		
Sr		
Mn	0.42	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	15 000	423
HCO_3	790	13
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	24	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

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WELL NAME Standard Hill	LOCATION A9-34-49-22		FILE REFERENCE NUMBER DV/PDN:045
ANALYST I. Nowak/A. Rehman		DATE ANALYSED YEAR 1988 MONTH 08 DAY 30	LAB SAMPLE NUMBER
FORMATION	FIELD		DATE YEAR 1988 MONTH 09 DAY 14
DATE SAMPLED YEAR 1988 MONTH 08 DAY 15	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) No

OBSERVED pH @ 17.5 °C 7.31

DENSITY @ 15°C, g/ml 1.0462

RESISTIVITY @ 25°C, ohm - cm 12

CONDUCTIVITY @ 25°C, µs/cm 78 700

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 7 930.

TOTAL DISSOLVED SOLIDS, mg/L 46 100.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

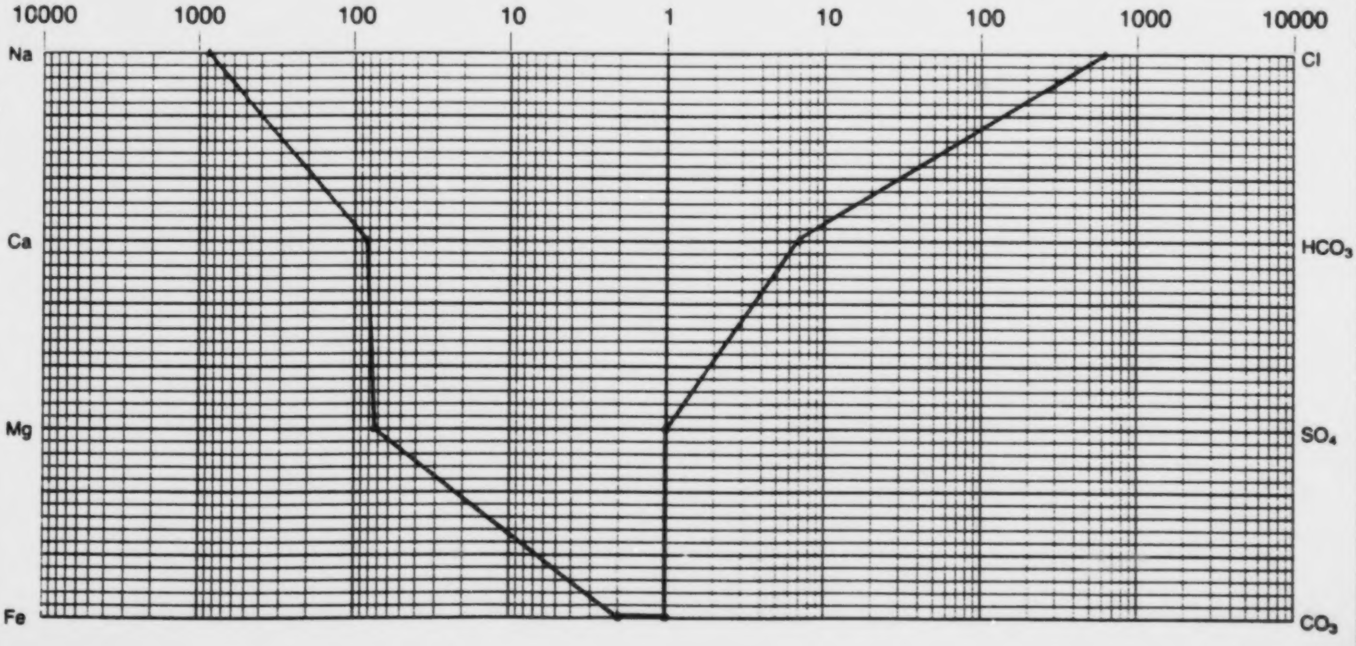
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 62.8 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	20 020	871
Ca	1 678	84
Mg	910	75
Fe	40.56	2
K	540	14
Ba		
Sr		
Mn	0.43	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	22 523	635
HCO_3	434	7
SO_4	ND	0
CO_3	ND	0
OH	ND	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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(6)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A9-34-49-22	FILE REFERENCE NUMBER Dv/PDN:044
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 06	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED YEAR 1988 MONTH 08 DAY 17	SAMPLED BY	
	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.66
DENSITY @ 15°C, g/ml 1.0194
RESISTIVITY @ 25°C, ohm - cm 27
CONDUCTIVITY @ 25°C, µs/cm 39 600.
OIL AND GREASE, mg/L

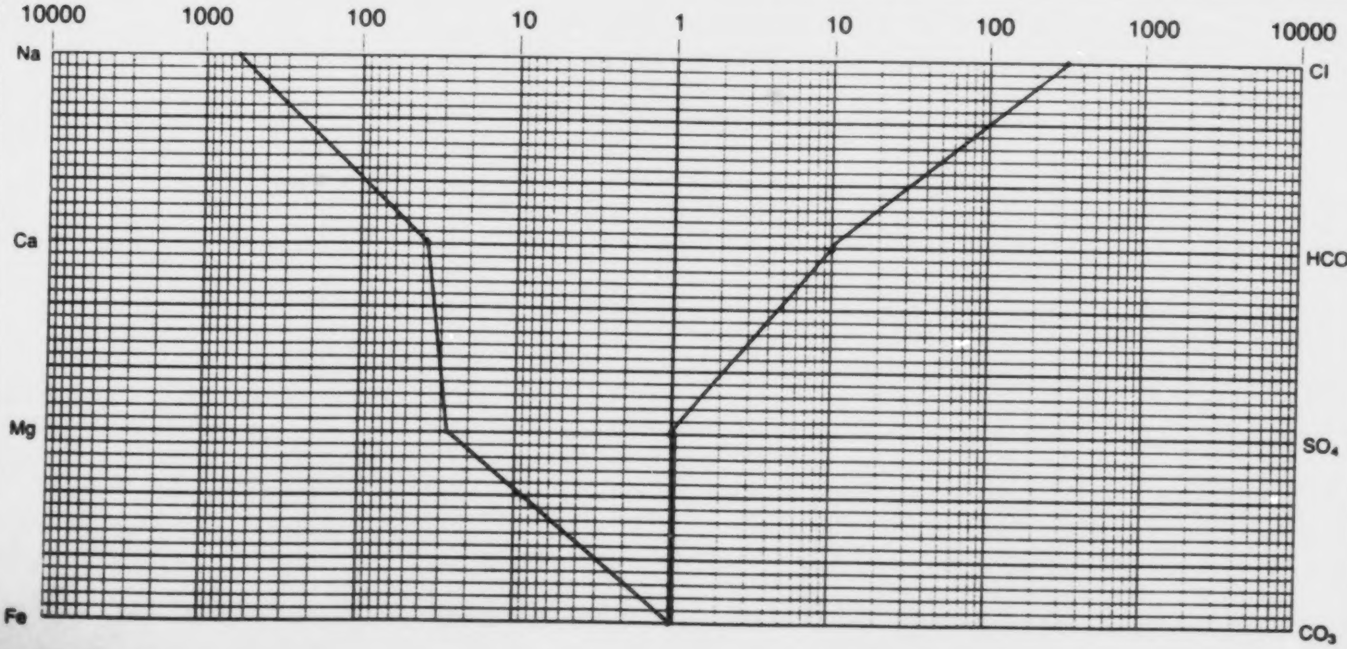
TOTAL HARDNESS, mg/L 3240.
TOTAL DISSOLVED SOLIDS, mg/L 27 200.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 74.8 dyne/cm

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Na	14 000	609
Ca	733	37
Mg	342	28
Fe	17.06	1
K	330	8
Ba		
Sr		
Mn	0.69	0
Si		

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Cl	11 131	314
HCO_3	590	10
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	21	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky
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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME: Standard Hill
LOCATION: A9-34-49-22
FILE REFERENCE NUMBER: DV/PDN:044
ANALYST: I. Nowak/A. Rehman
DATE ANALYSED: YEAR 1988 MONTH 09 DAY 06
LAB SAMPLE NUMBER:
FORMATION:
FIELD:
DATE: YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED: YEAR 1988 MONTH 08 DAY 18
SAMPLED BY:
SAMPLE CONTAINER(S): Plastic
PRESERVATIVE(S): None

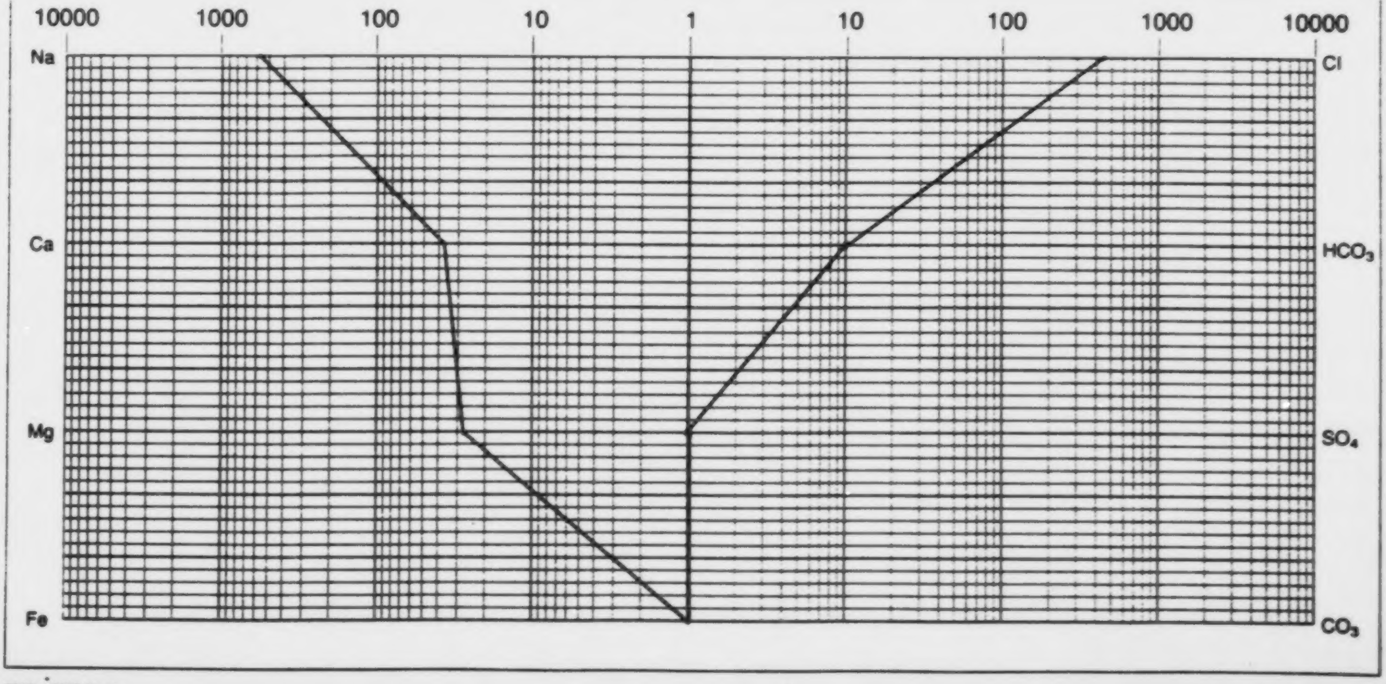
OBSERVED pH @ 23 °C 7.15
DENSITY @ 15°C, g/ml 1.0168
RESISTIVITY @ 25°C, ohm - cm 31
CONDUCTIVITY @ 25°C, μs/cm 33 700.
OIL AND GREASE, mg/L
TOTAL HARDNESS, mg/L 3220.
TOTAL DISSOLVED SOLIDS, mg/L 31 500.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 72.8 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	13 420	584
Ca	735	37
Mg	338	28
Fe	13.24	1
K	315	8
Ba		
Sr		
Mn	0.58	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	16 042	452
HCO_3	610	10
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	19	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A9-34-49-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988, MONTH 09, DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988, MONTH 09, DAY 19
DATE SAMPLED YEAR 1988, MONTH 08, DAY 19	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.36
DENSITY @ 15°C, g/ml 1.0266
RESISTIVITY @ 25°C, ohm - cm 28
CONDUCTIVITY @ 25°C, μs/cm 32 900
OIL AND GREASE, mg/L

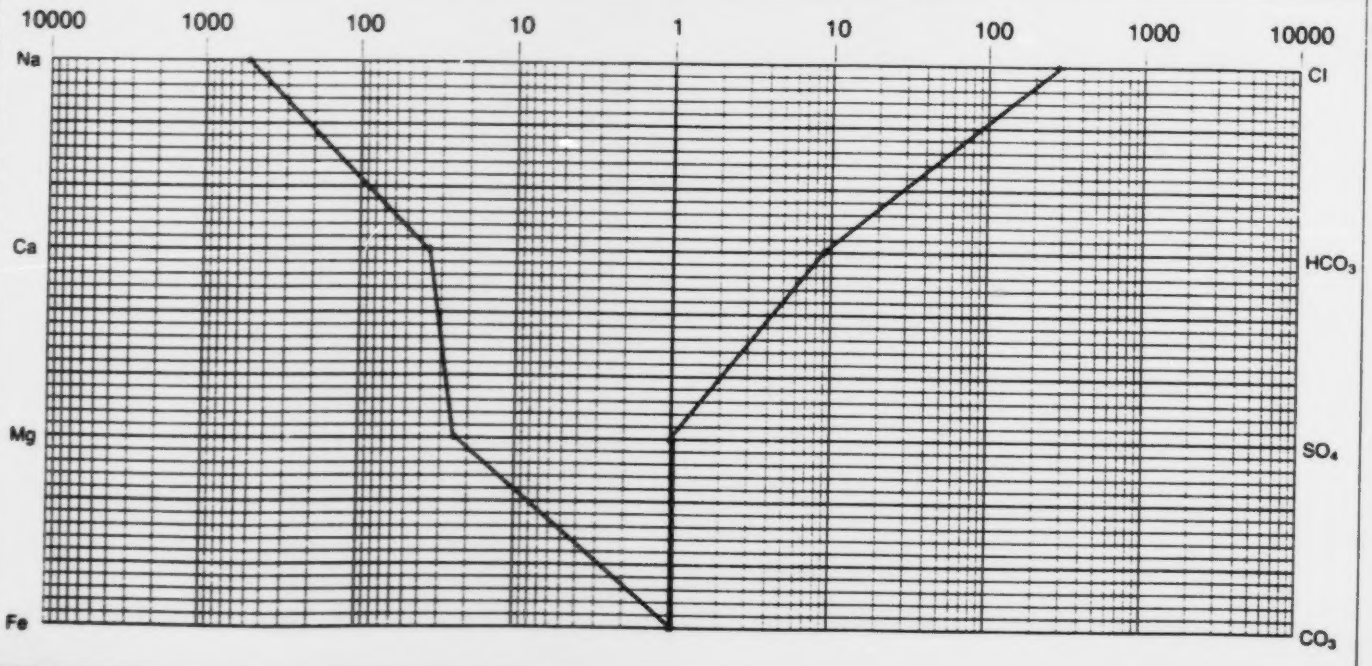
TOTAL HARDNESS, mg/L 2980.
TOTAL DISSOLVED SOLIDS, mg/L 24 400
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 71.3 Dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	12 330	536
Ca	715	36
Mg	292	24
Fe	13.41	1
K	270	7
Ba		
Sr		
Mn	0.55	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	10 240	289
HCO_3	527	9
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	17	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky HEAVY OIL LABORATORY WATER ANALYSIS

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WELL NAME Standard Hill	LOCATION 9-34-49-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988, MONTH 09, DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988, MONTH 09, DAY 19

DATE SAMPLED YEAR 1988, MONTH 08, DAY 20	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

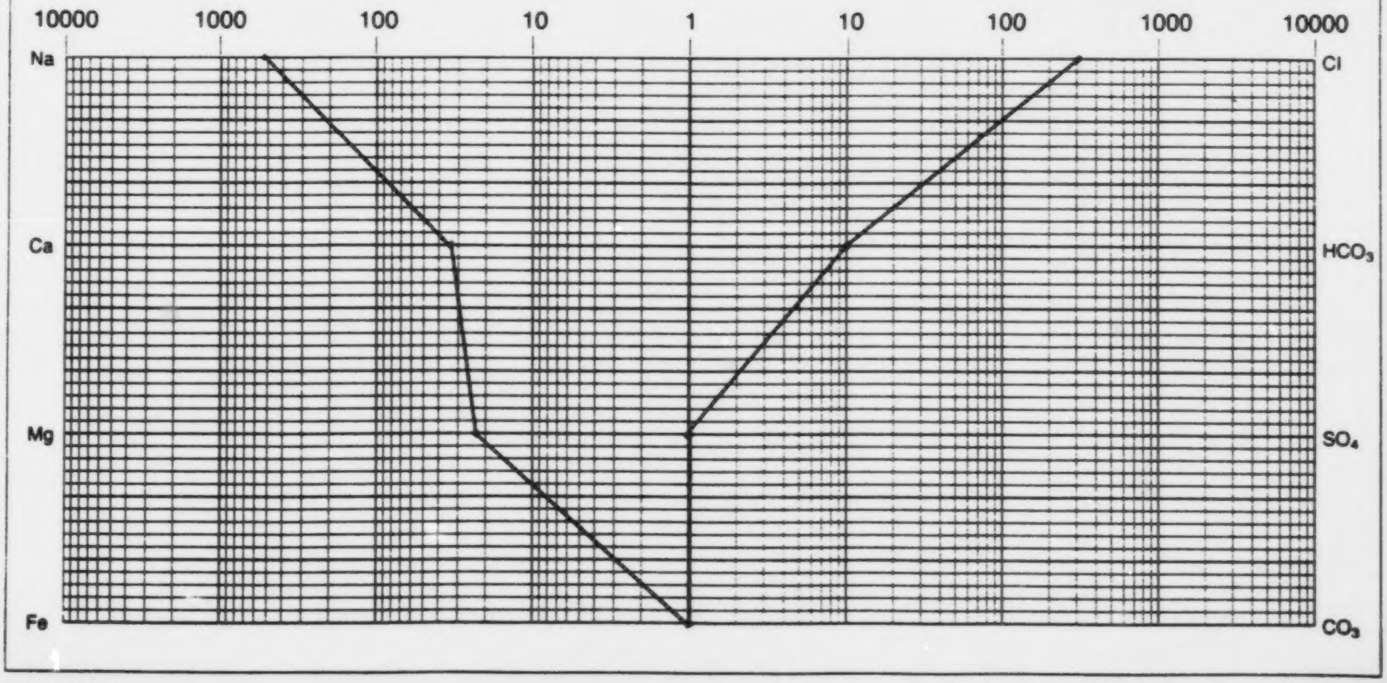
OBSERVED pH @ 22 °C 7.46
DENSITY @ 15°C, g/ml 1.0193
RESISTIVITY @ 25°C, ohm - cm 35
CONDUCTIVITY @ 25°C, µs/cm 33 400
OIL AND GREASE, mg/L
TOTAL HARDNESS, mg/L 2850
TOTAL DISSOLVED SOLIDS, mg/L 24 500
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 69.6 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	11 940	519
Ca	666	33
Mg	290	24
Fe	8.11	0
K	270	7
Ba		
Sr		
Mn	0.50	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	10 690	301
HCO_3	624	10
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	ND	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 9-34-49-22		FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman		DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD		DATE YEAR 1988 MONTH 09 DAY 21
DATE SAMPLED YEAR 1988 MONTH 08 DAY 21	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.13
DENSITY @ 15°C, g/ml 1.0214
RESISTIVITY @ 25°C, ohm - cm 25
CONDUCTIVITY @ 25°C, μs/cm 41 900
OIL AND GREASE, mg/L

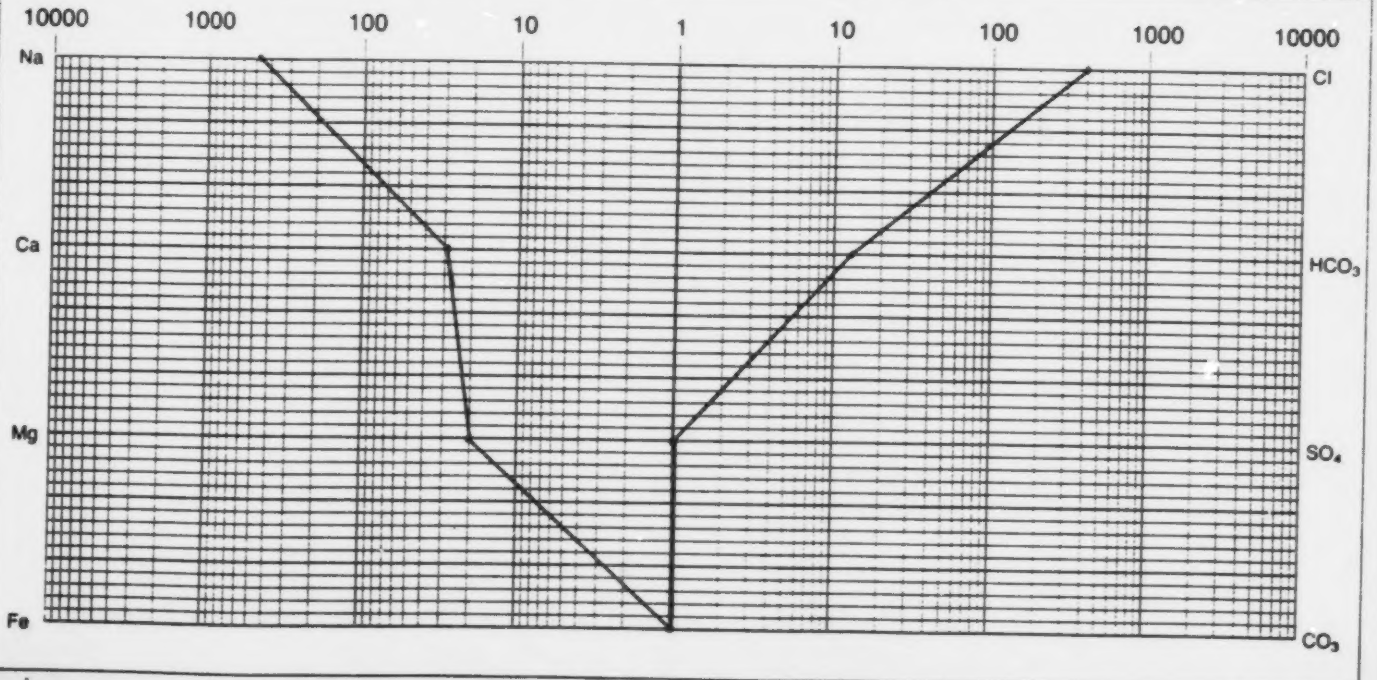
TOTAL HARDNESS, mg/L 2450.
TOTAL DISSOLVED SOLIDS, mg/L 27 100.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 66.0 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 880	473
Ca	574	29
Mg	248	20
Fe	10.93	1
K	210	5
Ba		
Sr		
Mn	0.50	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	14 300	403
HCO_3	878	14
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	24	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky
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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 9-34-49-22	FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 21

DATE SAMPLED YEAR 1988 MONTH 08 DAY 23	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.10
DENSITY @ 15°C, g/ml 1.0198
RESISTIVITY @ 25°C, ohm - cm 17
CONDUCTIVITY @ 25°C, μs/cm 55 200
OIL AND GREASE, mg/L

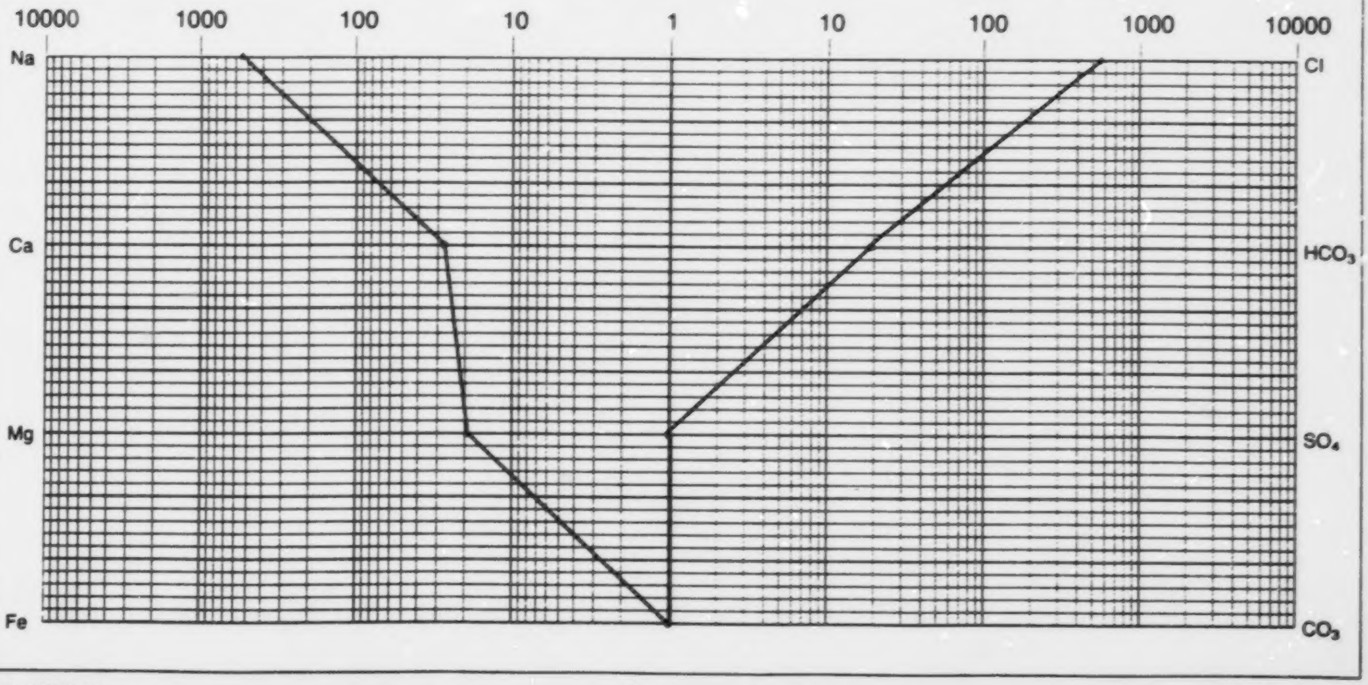
TOTAL HARDNESS, mg/L 2330.
TOTAL DISSOLVED SOLIDS, mg/L 32 500.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 62.8 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	9920	432
Ca	548	27
Mg	235	19
Fe	8.53	0
K	200	5
Ba		
Sr		
Mn	0.33	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	20 400	575
HCO_3	1141	19
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	ND	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A10-34-49-22	FILE REFERENCE NUMBER DV/PDN:045
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 08 DAY 30	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 14
DATE SAMPLED YEAR 1988 MONTH 08 DAY 15	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) No

OBSERVED pH @ 18.0 °C 7.73
DENSITY @ 15°C, g/ml 1.0440
RESISTIVITY @ 25°C, ohm - cm 13
CONDUCTIVITY @ 25°C, μs/cm 76 900
OIL AND GREASE, mg/L

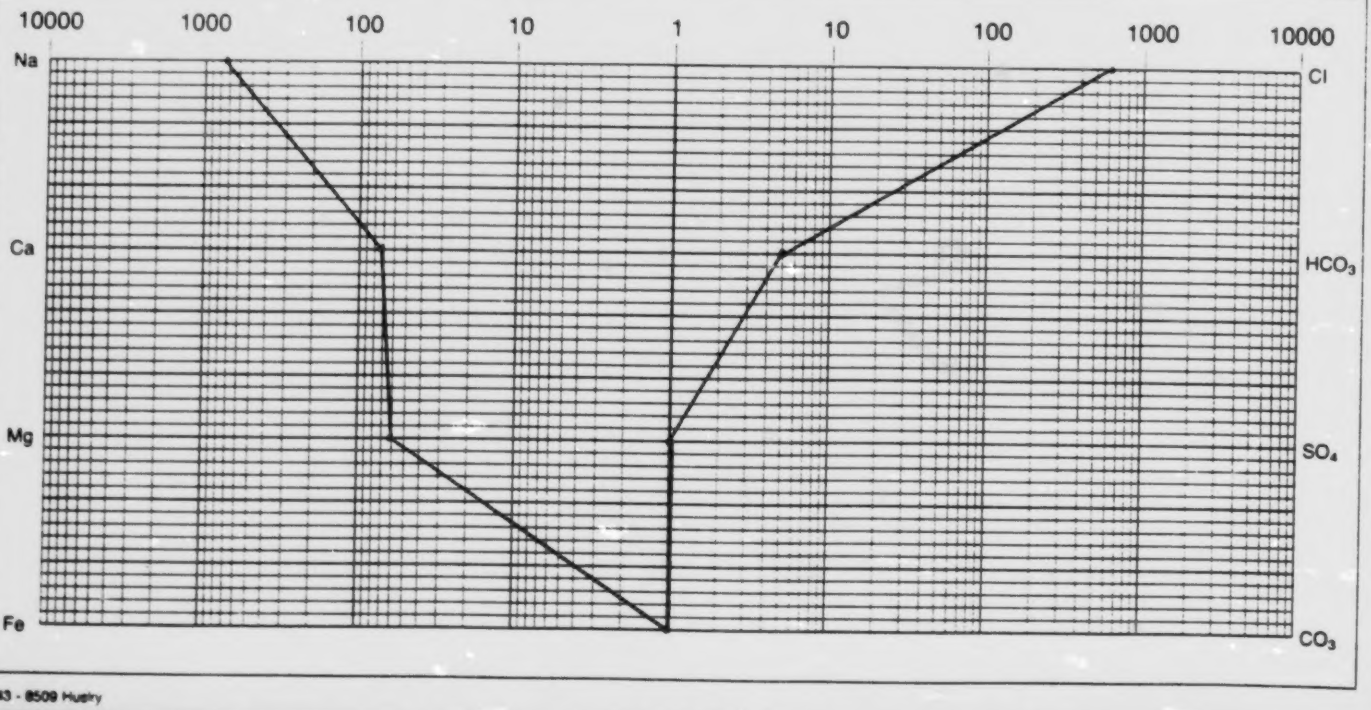
TOTAL HARDNESS, mg/L 6730.
TOTAL DISSOLVED SOLIDS, mg/L 41 900.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 63.4 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	16 840	733
Ca	1 447	72
Mg	760	63
Fe	22.14	1
K	480	12
Ba		
Sr		
Mn	0.29	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	22 062	622
HCO_3	293	5
SO_4	ND	0
CO_3	ND	0
OH	ND	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A10-34-49-22	FILE REFERENCE NUMBER DV/PDN:045
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 08 DAY 30	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 14
DATE SAMPLED YEAR 1988 MONTH 08 DAY 16	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) No

OBSERVED pH @ 20 °C 7.72
DENSITY @ 15°C, g/ml 1.0212
RESISTIVITY @ 25°C, ohm - cm 24
CONDUCTIVITY @ 25°C, μs/cm 42 100
OIL AND GREASE, mg/L

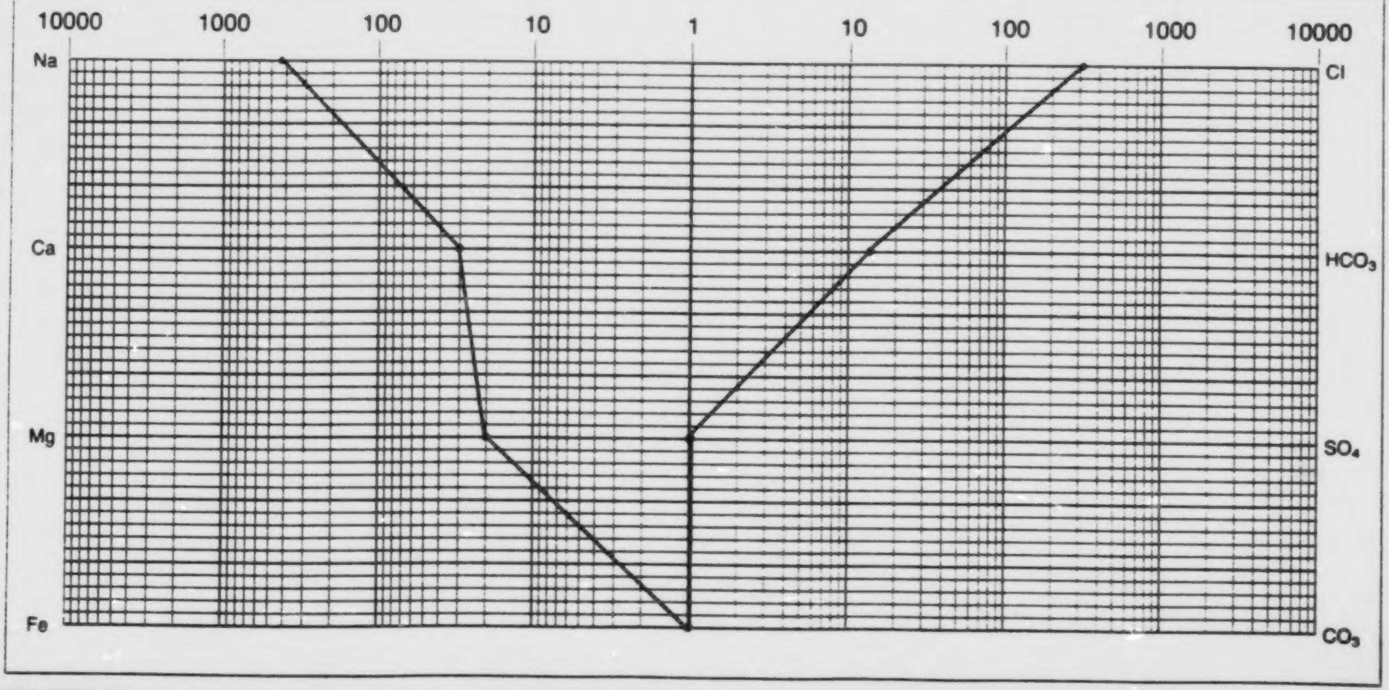
TOTAL HARDNESS, mg/L 2540.
TOTAL DISSOLVED SOLIDS, mg/L 24 300
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 72.8 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 040	437
Ca	608	30
Mg	249	20
Fe	10.44	1
K	420	11
Ba		
Sr		
Mn	0.51	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	12 024	339
HCO_3	888	15
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	25	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
(7)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A10-34-49-22	FILE REFERENCE NUMBER DV/PDN:044
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 06	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED YEAR 1988 MONTH 08 DAY 17	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.07
DENSITY @ 15°C, g/ml 1.0176
RESISTIVITY @ 25°C, ohm - cm 29
CONDUCTIVITY @ 25°C, µs/cm 36 700.
OIL AND GREASE, mg/L

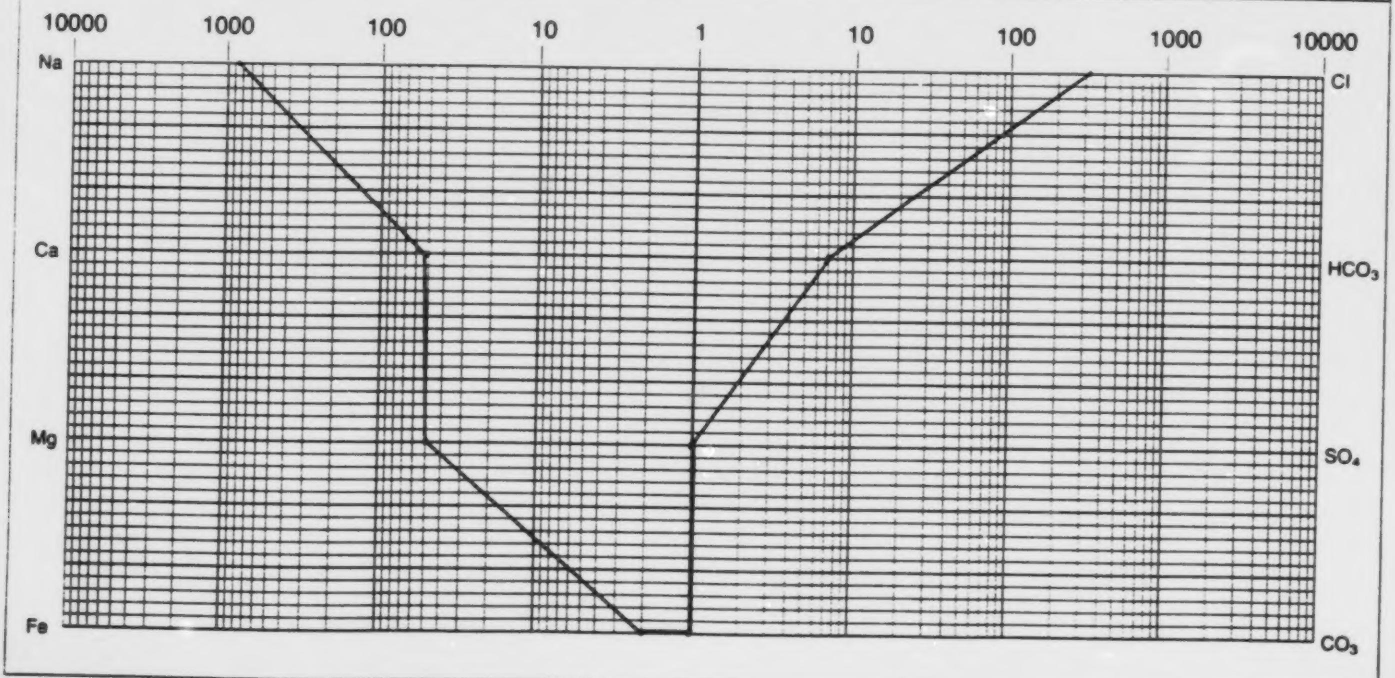
TOTAL HARDNESS, mg/L 5150.
TOTAL DISSOLVED SOLIDS, mg/L 33 600.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 71.5 dyne/cm

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Na	19 530	850
Ca	1061	53
Mg	610	50
Fe	44.04	2
K	458	12
Ba		
Sr		
Mn	0.85	0
Si		

ION	CONCENTRATION mg/L	CONCENTRATION meq/L
Cl	11 421	322
HCO_3	415	7
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	20	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky

HEAVY OIL LABORATORY WATER ANALYSIS

(15)

WELL NAME: Standard Hill
LOCATION: A10-34-49-22
FILE REFERENCE NUMBER: DV/PDN:044
ANALYST: I. Nowak/A. Rehman
DATE ANALYSED: YEAR 1988 MONTH 09 DAY 06
LAB SAMPLE NUMBER:
FORMATION:
FIELD:
DATE: YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED: YEAR 1988 MONTH 08 DAY 18
SAMPLED BY:
SAMPLE CONTAINER(S): Plastic
PRESERVATIVE(S): None

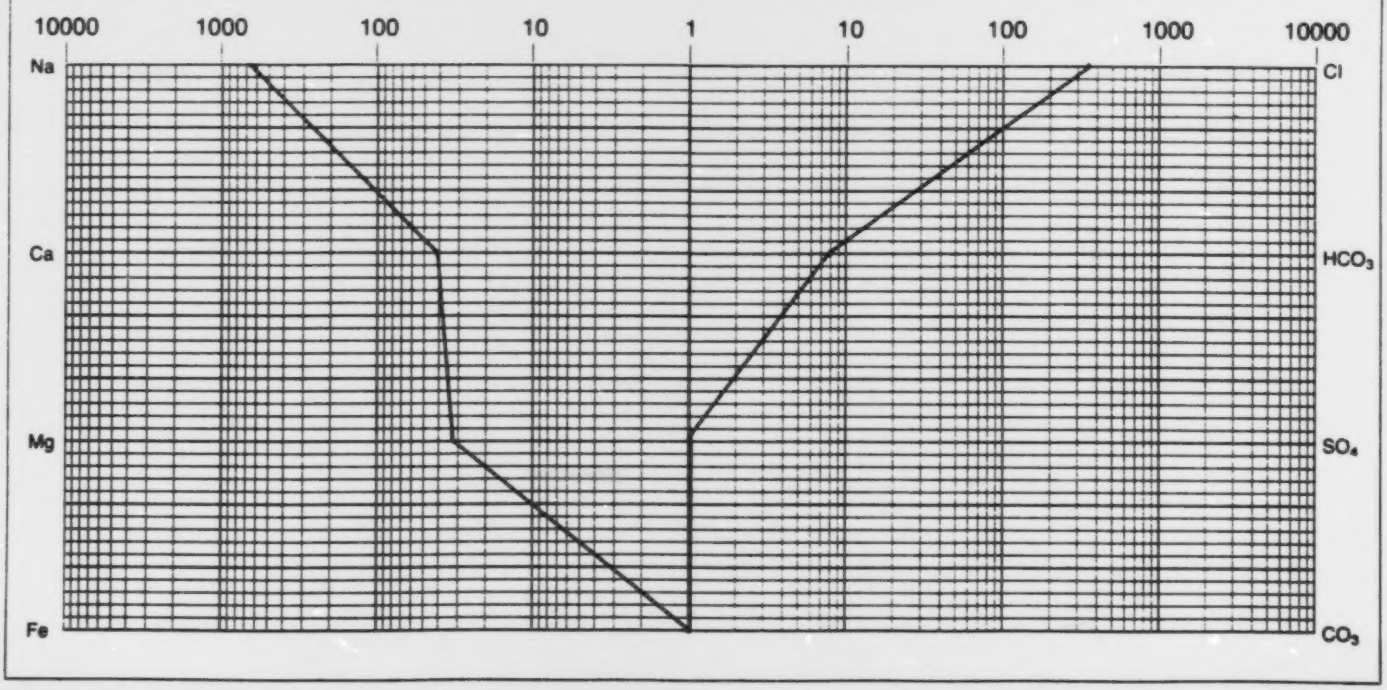
OBSERVED pH @ 23 °C: 7.44
DENSITY @ 15°C, g/ml: 1.0172
RESISTIVITY @ 25°C, ohm - cm: 30
CONDUCTIVITY @ 25°C, μs/cm: 36 600.
OIL AND GREASE, mg/L:
TOTAL HARDNESS, mg/L: 3610.
TOTAL DISSOLVED SOLIDS, mg/L: 30 300.
TOTAL SUSPENDED SOLIDS, mg/L:
VOLATILE SUSPENDED SOLIDS, mg/L:
FIXED SUSPENDED SOLIDS, mg/L:

Surface Tension - 71.8 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	15 610	679
Ca	812	41
Mg	386	32
Fe	10.44	1
K	368	9
Ba		
Sr		
Mn	0.50	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	12 627	356
HCO_3	507	8
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	19	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



0343 - 8509

Husky
(8)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME: Standard Hill
LOCATION: A10-34-49-22
FILE REFERENCE NUMBER: DV/PDN:049
ANALYST: I. Nowak/A. Rehman
DATE ANALYSED: YEAR 1988 | MONTH 09 | DAY 12
LAB SAMPLE NUMBER:
FORMATION:
FIELD:
DATE: YEAR 1988 | MONTH 09 | DAY 19
DATE SAMPLED: YEAR 1988 | MONTH 08 | DAY 19
SAMPLED BY:
SAMPLE CONTAINER(S): Plastic
PRESERVATIVE(S): None

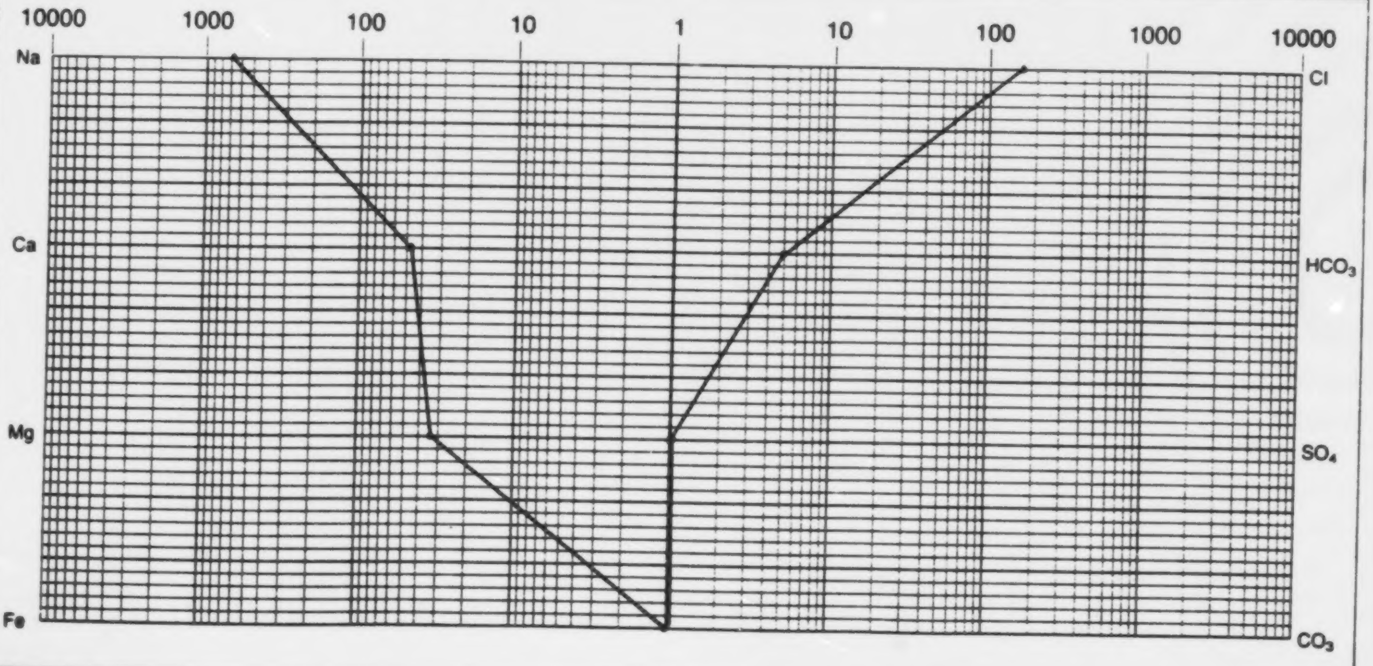
OBSERVED pH @ 22 °C: 7.58
DENSITY @ 15°C, g/ml: 1.0353
RESISTIVITY @ 25°C, ohm - cm: 48
CONDUCTIVITY @ 25°C, µs/cm: 21 400
OIL AND GREASE, mg/L:
TOTAL HARDNESS, mg/L: 3980.
TOTAL DISSOLVED SOLIDS, mg/L: 23 600.
TOTAL SUSPENDED SOLIDS, mg/L:
VOLATILE SUSPENDED SOLIDS, mg/L:
FIXED SUSPENDED SOLIDS, mg/L:

Surface Tension - 72.5 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	15 640	680
Ca	934	47
Mg	400	33
Fe	11.18	1
K	350	9
Ba		
Sr		
Mn	0.61	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	6020	170
HCO_3	293	5
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	ND	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



0343 - 8509

Husky
(19)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME: Standard Hill
LOCATION: 10-34-49-22
FILE REFERENCE NUMBER: DV/PDN:049
ANALYST: I. Nowak/A. Rehman
DATE ANALYSED: YEAR 1988 MONTH 09 DAY 12
LAB SAMPLE NUMBER:
FORMATION:
FIELD:
DATE: YEAR 1988 MONTH 09 DAY 19
DATE SAMPLED: YEAR 1988 MONTH 08 DAY 20
SAMPLED BY:
SAMPLE CONTAINER(S): Plastic
PRESERVATIVE(S): None

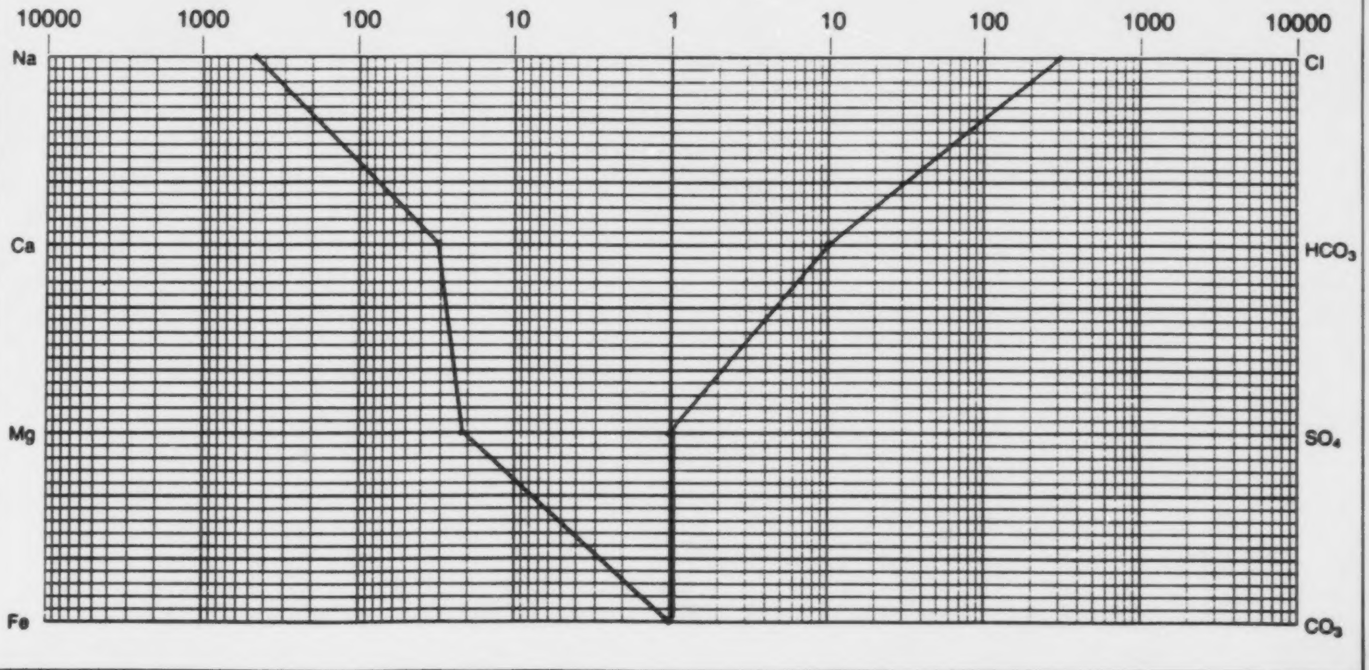
OBSERVED pH @ 22 °C: 7.37
DENSITY @ 15°C, g/ml: 1.0245
RESISTIVITY @ 25°C, ohm - cm: 35
CONDUCTIVITY @ 25°C, µs/cm: 30 000.
OIL AND GREASE, mg/L:
TOTAL HARDNESS, mg/L: 2670.
TOTAL DISSOLVED SOLIDS, mg/L: 23 400.
TOTAL SUSPENDED SOLIDS, mg/L:
VOLATILE SUSPENDED SOLIDS, mg/L:
FIXED SUSPENDED SOLIDS, mg/L:

Surface Tension - 65.3 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 940	476
Ca	624	31
Mg	270	22
Fe	11.54	1
K	250	6
Ba		
Sr		
Mn	0.50	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	10 680	301
HCO_3	595	10
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	17	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



0343 - 8509

Husky
(7)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 10-34-49-22	FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988, MONTH 09, DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988, MONTH 09, DAY 21
DATE SAMPLED YEAR 1988, MONTH 08, DAY 21	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) None

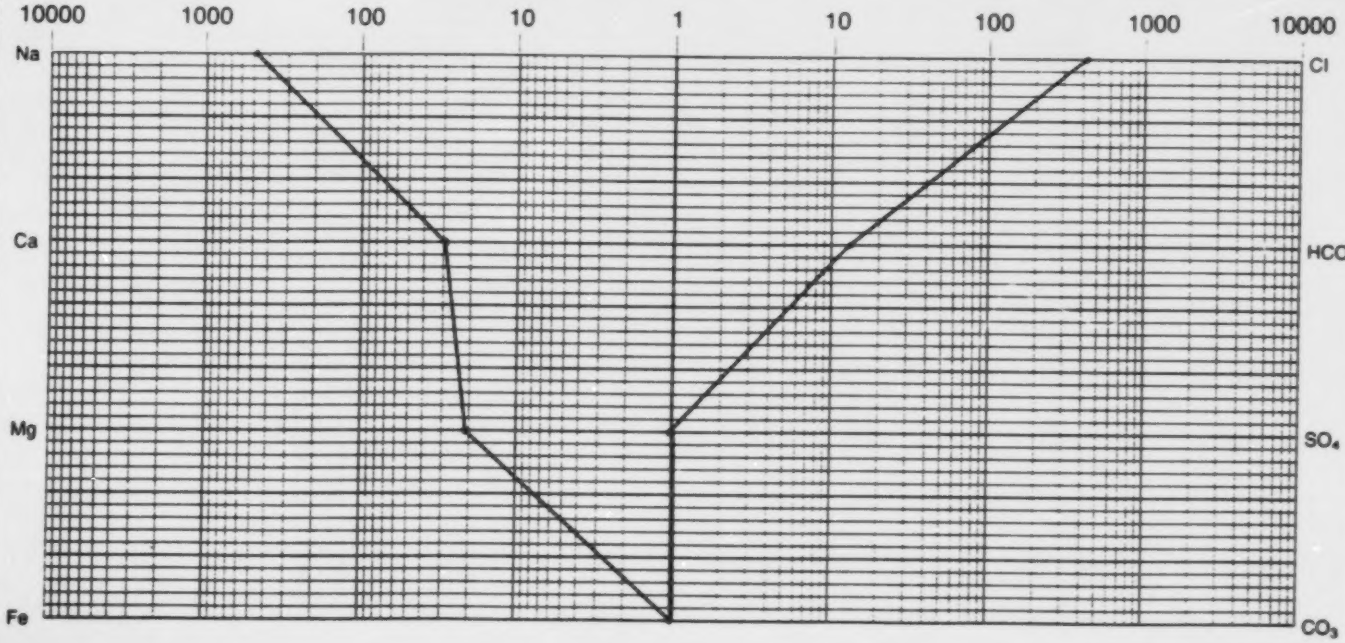
OBSERVED pH @ 22 °C	7.07	TOTAL HARDNESS, mg/L	2460.
DENSITY @ 15°C, g/ml	1.0214	TOTAL DISSOLVED SOLIDS, mg/L	28 300.
RESISTIVITY @ 25°C, ohm - cm	19	TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, µs/cm	48 100	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension - 67.3 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 990	478
Ca	572	29
Mg	250	21
Fe	6.02	0
K	220	6
Ba		
Sr		
Mn	0.41	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	15 400	434
HCO_3	878	14
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	24	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky
(18)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 10-34-49-22		FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988, MONTH 09, DAY 16		LAB SAMPLE NUMBER
FORMATION	FIELD		DATE YEAR 1988, MONTH 09, DAY 21
DATE SAMPLED YEAR 1988, MONTH 08, DAY 23	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

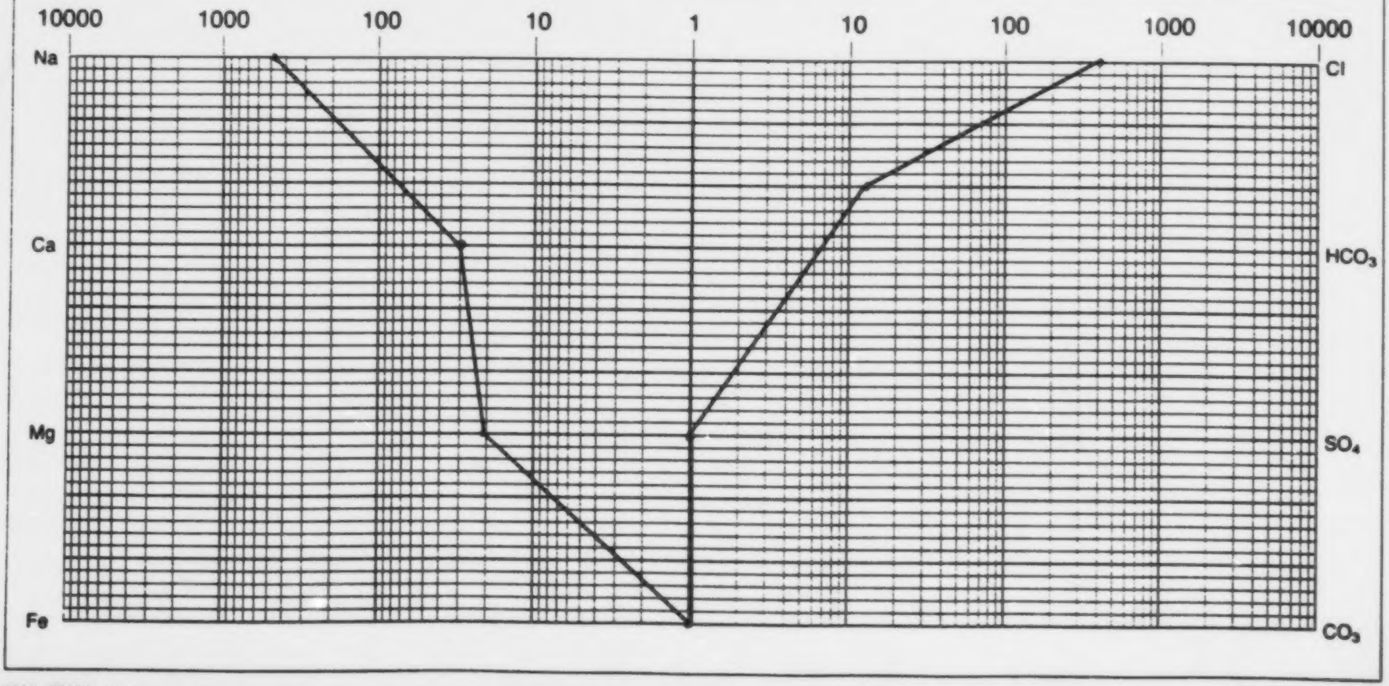
OBSERVED pH @ 22 °C	7.04	TOTAL HARDNESS, mg/L	2550.
DENSITY @ 15°C, g/ml	1.0220	TOTAL DISSOLVED SOLIDS, mg/L	27 600
RESISTIVITY @ 25°C, ohm - cm	27	TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, μs/cm	39 900	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension - 74.2 dyne/cm

ION	CONCENTRATION mg/L	meq/L
Na	11 090	482
Ca	599	30
Mg	257	21
Fe	5.62	0
K	220	6
Ba		
Sr		
Mn	0.34	0
Si		

ION	CONCENTRATION mg/L	meq/L
Cl	14 600	412
HCO_3	829	14
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	ND	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



2343 - 8509

Husky
(18)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A16-34-49-22		FILE REFERENCE NUMBER DV/PDN:044
ANALYST I. Nowak/A. Rehman		DATE ANALYSED YEAR 1988 MONTH 09 DAY 06	LAB SAMPLE NUMBER
FORMATION	FIELD		DATE YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED YEAR 1988 MONTH 08 DAY 18	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) No

OBSERVED pH @ 23 °C 7.12

DENSITY @ 15°C, g/ml 1.0223

RESISTIVITY @ 25°C, ohm - cm 22

CONDUCTIVITY @ 25°C, μs/cm 45 400.

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 3040.

TOTAL DISSOLVED SOLIDS, mg/L 30 900.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

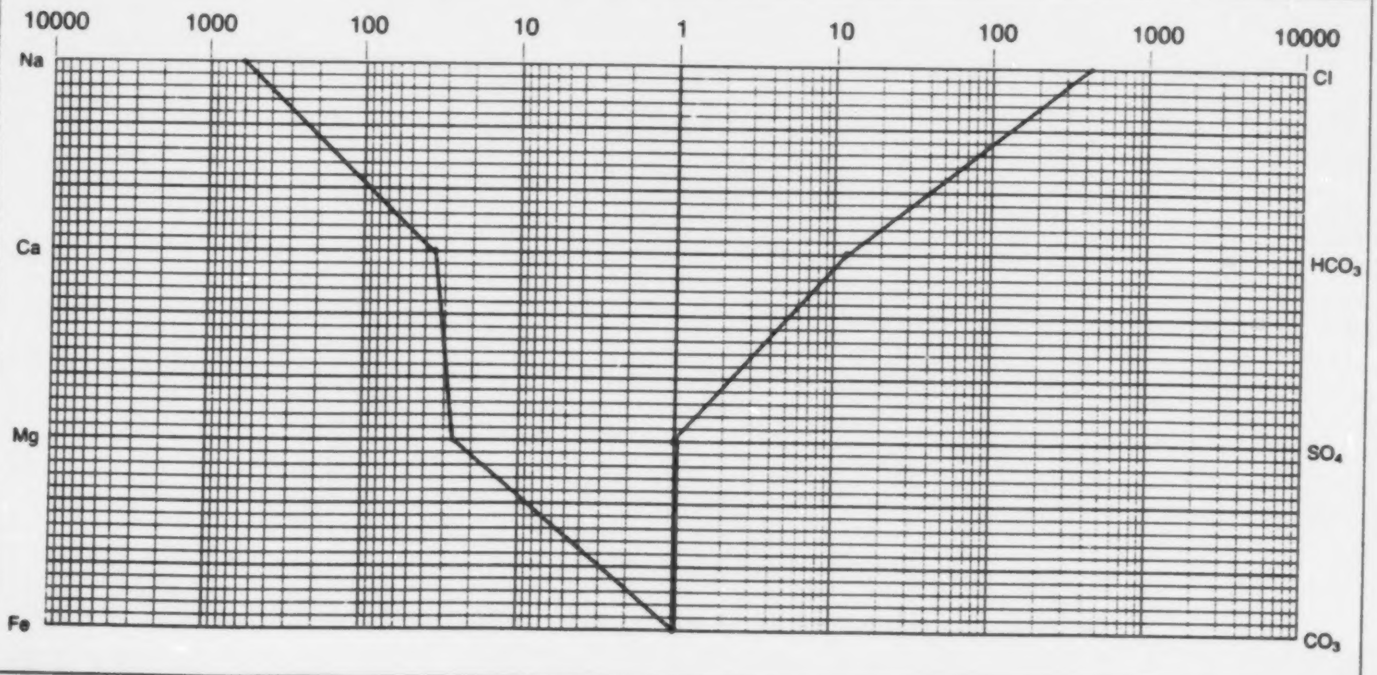
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 65.8 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	13 830	602
Ca	694	35
Mg	318	26
Fe	2.35	0
K	307	8
Ba		
Sr		
Mn	1.46	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	14 922	421
HCO_3	805	13
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	24	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



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Husky

HEAVY OIL LABORATORY WATER ANALYSIS

(12)

WELL NAME Standard Hill	LOCATION A16-34-49-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 19
DATE SAMPLED YEAR 1988 MONTH 08 DAY 19 SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.68

DENSITY @ 15°C, g/ml 1.0207

RESISTIVITY @ 25°C, ohm - cm 19

CONDUCTIVITY @ 25°C, µs/cm 50 300

OIL AND GREASE, mg/L

TOTAL HARDNESS, mg/L 2440.

TOTAL DISSOLVED SOLIDS, mg/L 30 300.

TOTAL SUSPENDED SOLIDS, mg/L

VOLATILE SUSPENDED SOLIDS, mg/L

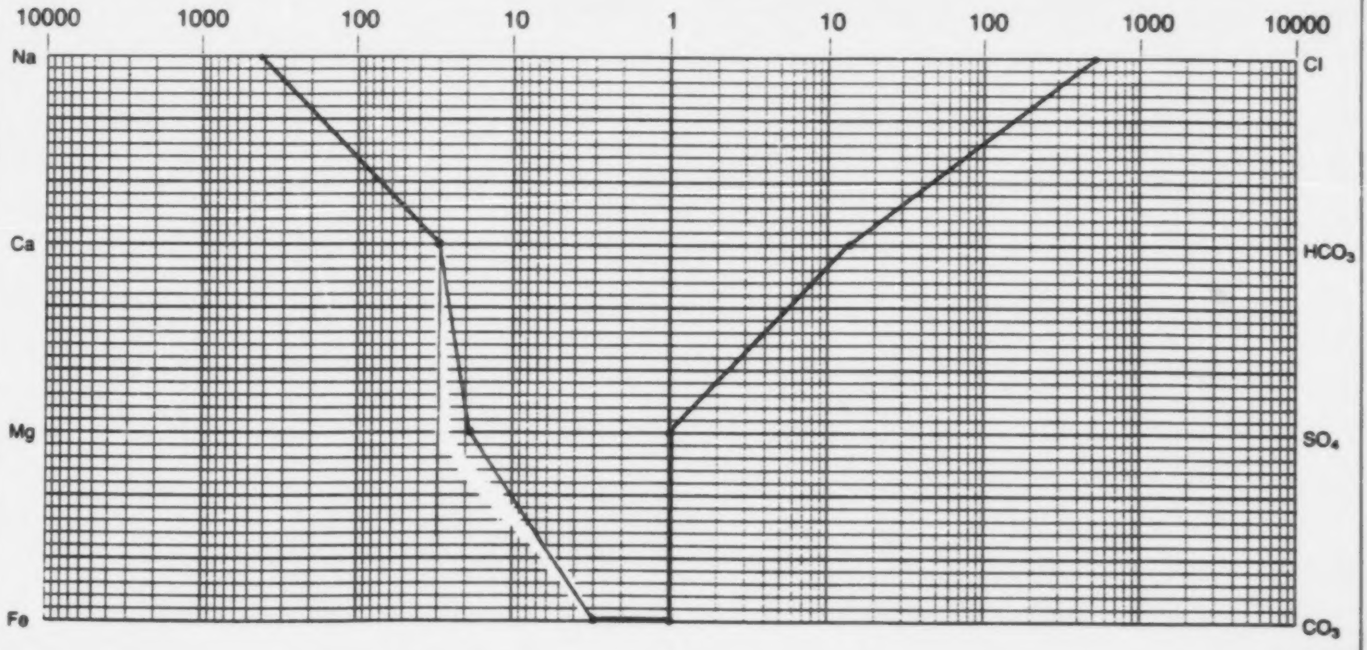
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 71.5 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	9810	427
Ca	596	30
Mg	232	19
Fe	62.13	3
K	200	5
Ba		
Sr		
Mn	1.04	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	18 460	521
HCO_3	922	15
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	ND	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



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Husky
(23)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 16-34-49-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 19
DATE SAMPLED YEAR 1988 MONTH 08 DAY 20	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.48
DENSITY @ 15°C, g/ml 1.0251
RESISTIVITY @ 25°C, ohm - cm 49
CONDUCTIVITY @ 25°C, µs/cm 20 300
OIL AND GREASE, mg/L

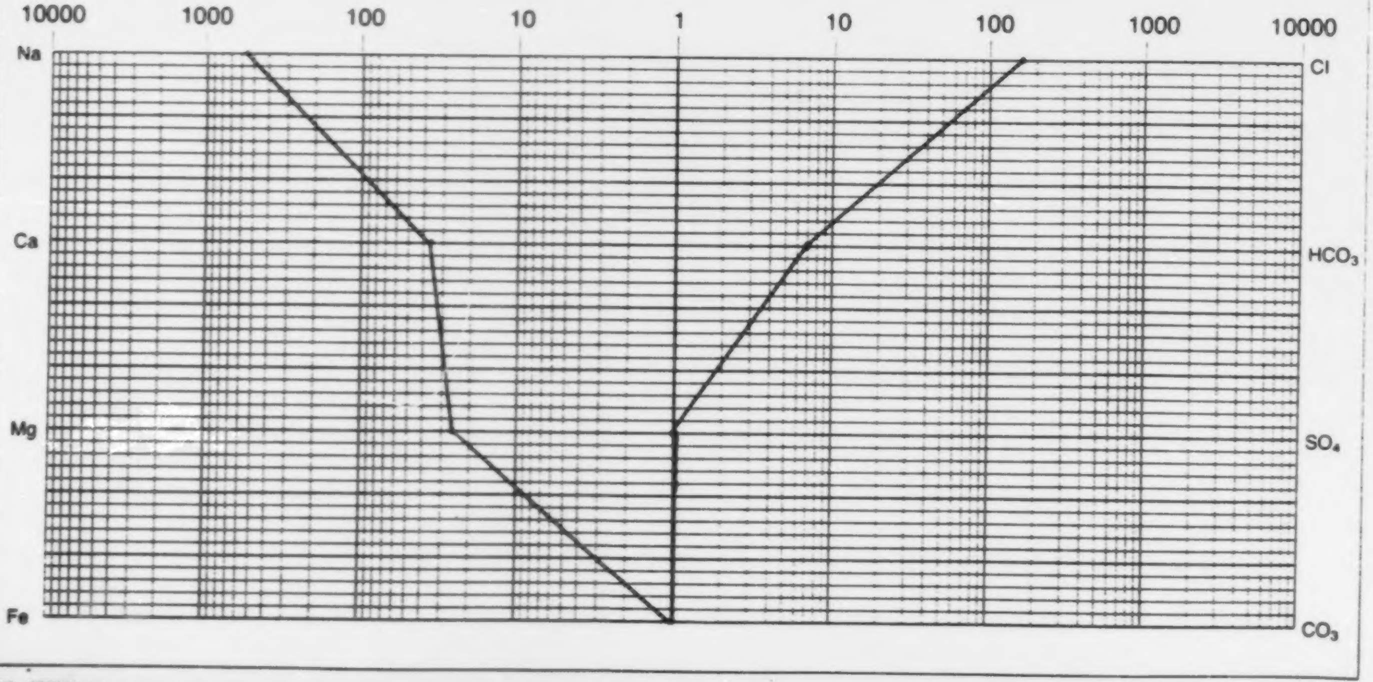
TOTAL HARDNESS, mg/L 3110.
TOTAL DISSOLVED SOLIDS, mg/L 20 700.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 58.8 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	12 840	559
Ca	718	36
Mg	320	26
Fe	17.54	1
K	300	8
Ba		
Sr		
Mn	0.72	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	6040	170
HCO_3	415	7
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	11	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky

(11)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 16-34-49-22		FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman		DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD		DATE YEAR 1988 MONTH 09 DAY 21
DATE SAMPLED YEAR 1988 MONTH 08 DAY 21	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

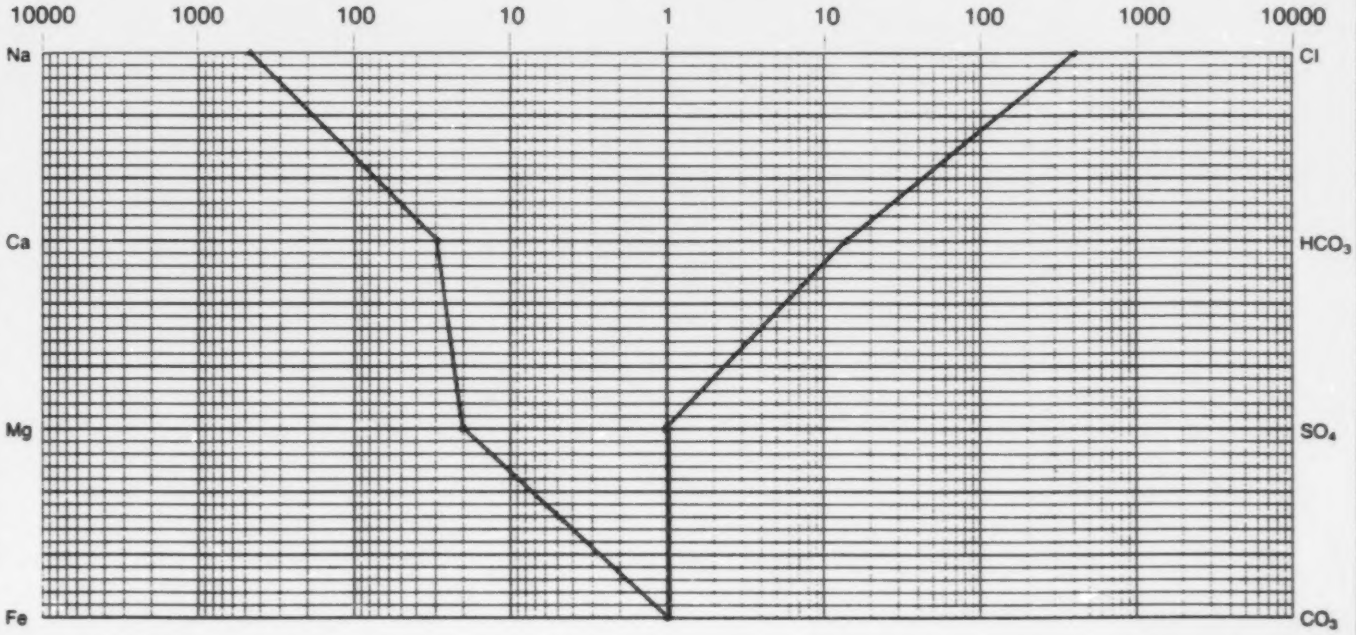
OBSERVED pH @ 22 °C	6.97	TOTAL HARDNESS, mg/L	2490.
DENSITY @ 15°C, g/ml	1.0212	TOTAL DISSOLVED SOLIDS, mg/L	27 500.
RESISTIVITY @ 25°C, ohm - cm	24	TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, µs/cm	42 500	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension - 67.9 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	10 980	478
Ca	591	29
Mg	246	20
Fe	10.96	1
K	210	5
Ba		
Sr		
Mn	0.50	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	14 500	409
HCO_3	907	15
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	23	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



Husky
(21)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 16-34-49-22	FILE REFERENCE NUMBER DV/PDN:053
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 16	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 21
DATE SAMPLED YEAR 1988 MONTH 08 DAY 23 SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

OBSERVED pH @ 22 °C 7.17
DENSITY @ 15°C, g/ml 1.0238
RESISTIVITY @ 25°C, ohm - cm 47
CONDUCTIVITY @ 25°C, μs/cm 24 100
OIL AND GREASE, mg/L

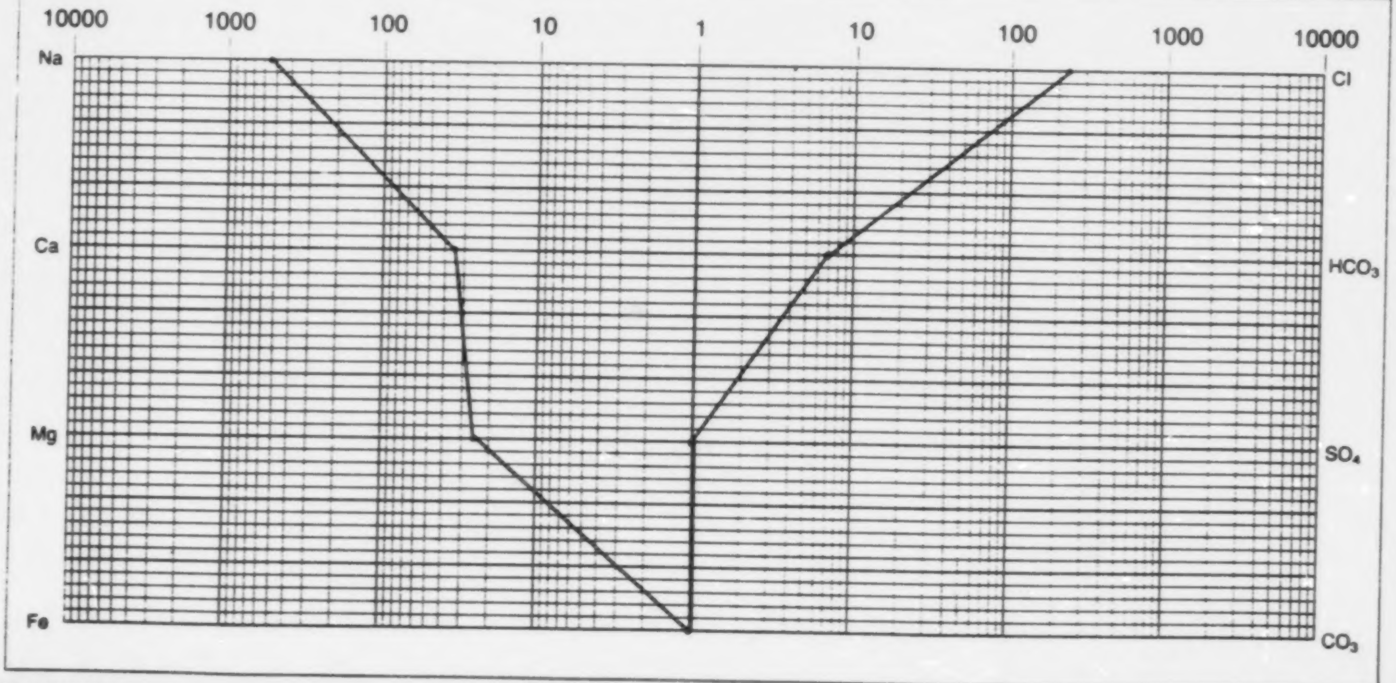
TOTAL HARDNESS, mg/L 2950
TOTAL DISSOLVED SOLIDS, mg/L 22 600
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 65.0 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	12 350	537
Ca	675	34
Mg	308	25
Fe	15.65	1
K	260	7
Ba		
Sr		
Mn	0.47	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	8510	240
HCO_3	449	7
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	14	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meq/L)



0343 - 8509

Husky
(4)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A5-2-50-22 Satellite	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 19

DATE SAMPLED YEAR 1988 MONTH 08 DAY 19	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

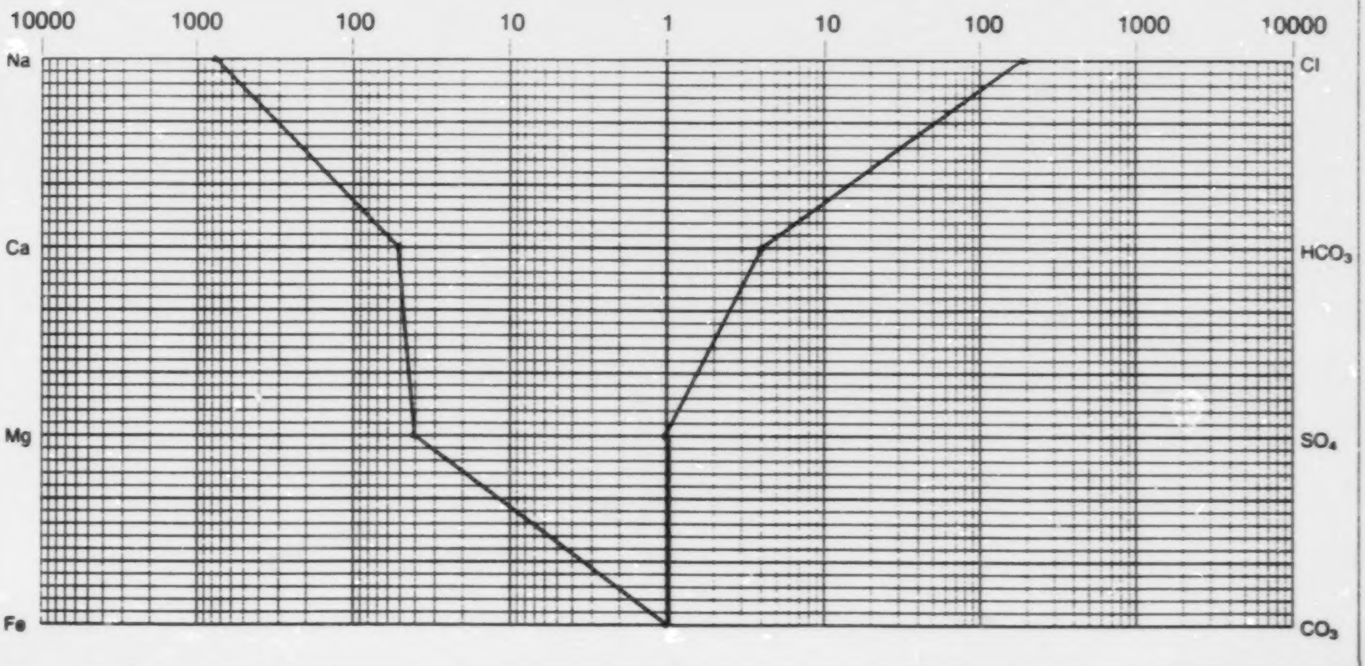
OBSERVED pH @ 22 °C	7.50	TOTAL HARDNESS, mg/L	4600.
DENSITY @ 15°C, g/ml	1.0230	TOTAL DISSOLVED SOLIDS, mg/L	26 600.
RESISTIVITY @ 25°C, ohm - cm	48	TOTAL SUSPENDED SOLIDS, mg/L	
CONDUCTIVITY @ 25°C, µs/cm	21 000	VOLATILE SUSPENDED SOLIDS, mg/L	
OIL AND GREASE, mg/L		FIXED SUSPENDED SOLIDS, mg/L	

Surface Tension - 72.3 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	17 550	763
Ca	1024	51
Mg	498	41
Fe	10.18	1
K	370	9
Ba		
Sr		
Mn	0.35	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	6830	193
HCO_3	268	4
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	11	1
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky
(15)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A10-35-49-22	FILE REFERENCE NUMBER DV/PDN:045
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 08 DAY 30	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 14
DATE SAMPLED YEAR 1988 MONTH 08 DAY 16	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) No

OBSERVED pH @ 21 °C 6.98
DENSITY @ 15°C, g/ml 1.0440
RESISTIVITY @ 25°C, ohm - cm 12
CONDUCTIVITY @ 25°C, µs/cm 79 700.
OIL AND GREASE, mg/L

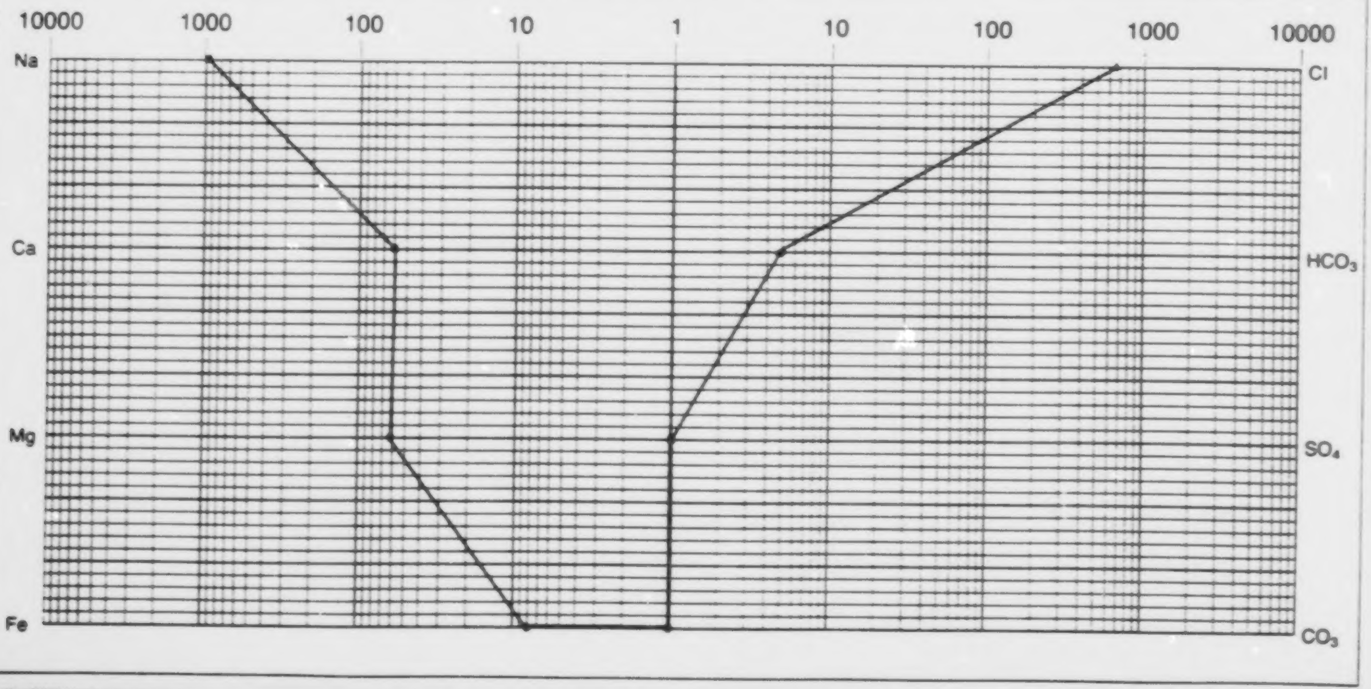
TOTAL HARDNESS, mg/L 6050.
TOTAL DISSOLVED SOLIDS, mg/L 49 000.
TOTAL SUSPENDED SOLIDS, mg/L
VOLATILE SUSPENDED SOLIDS, mg/L
FIXED SUSPENDED SOLIDS, mg/L

Surface Tension - 71.2 dyne/cm

ION	CONCENTRATION	
	mg/L	meq/L
Na	22 100	961
Ca	1 207	60
Mg	740	61
Fe	142.6	8
K	690	18
Ba		
Sr		
Mn	0.69	0
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl	23 809	671
HCO_3	283	5
SO_4	ND	0
CO_3	ND	0
OH	ND	0
F	ND	0
NO_3	ND	0
PO_4	ND	0

LOGARITHMIC WATER PATTERN (meg/L)



Husky
(8)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A10-35-49-22	FILE REFERENCE NUMBER DV/PDN:044
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 06	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED YEAR 1988 MONTH 08 DAY 17	SAMPLED BY	SAMPLE CONTAINER(S) Plastic
		PRESERVATIVE(S) None

NO WATER (OIL ONLY)

OBSERVED pH @ _____ °C ____________________

DENSITY @ 15°C, g/ml ____________________

RESISTIVITY @ 25°C, ohm - cm ____________________

CONDUCTIVITY @ 25°C, µs/cm ____________________

OIL AND GREASE, mg/L ____________________

TOTAL HARDNESS, mg/L ____________________

TOTAL DISSOLVED SOLIDS, mg/L ____________________

TOTAL SUSPENDED SOLIDS, mg/L ____________________

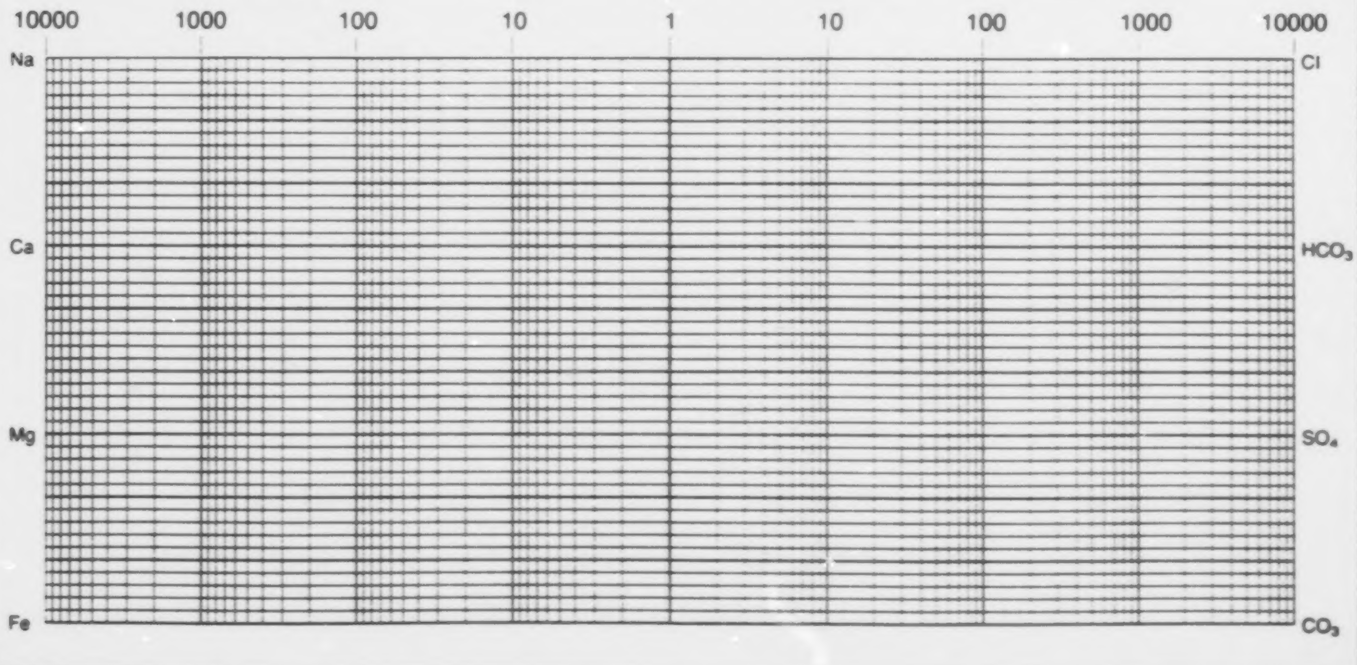
VOLATILE SUSPENDED SOLIDS, mg/L ____________________

FIXED SUSPENDED SOLIDS, mg/L ____________________

ION	CONCENTRATION	
	mg/L	meq/L
Na		
Ca		
Mg		
Fe		
K		
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl		
HCO_3		
SO_4		
CO_3		
OH		

LOGARITHMIC WATER PATTERN (meq/L)



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Husky
(16)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A10-35-49-22	FILE REFERENCE NUMBER DV/PDN:044
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 06	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 15
DATE SAMPLED YEAR 1988 MONTH 08 DAY 18 SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

NO WATER

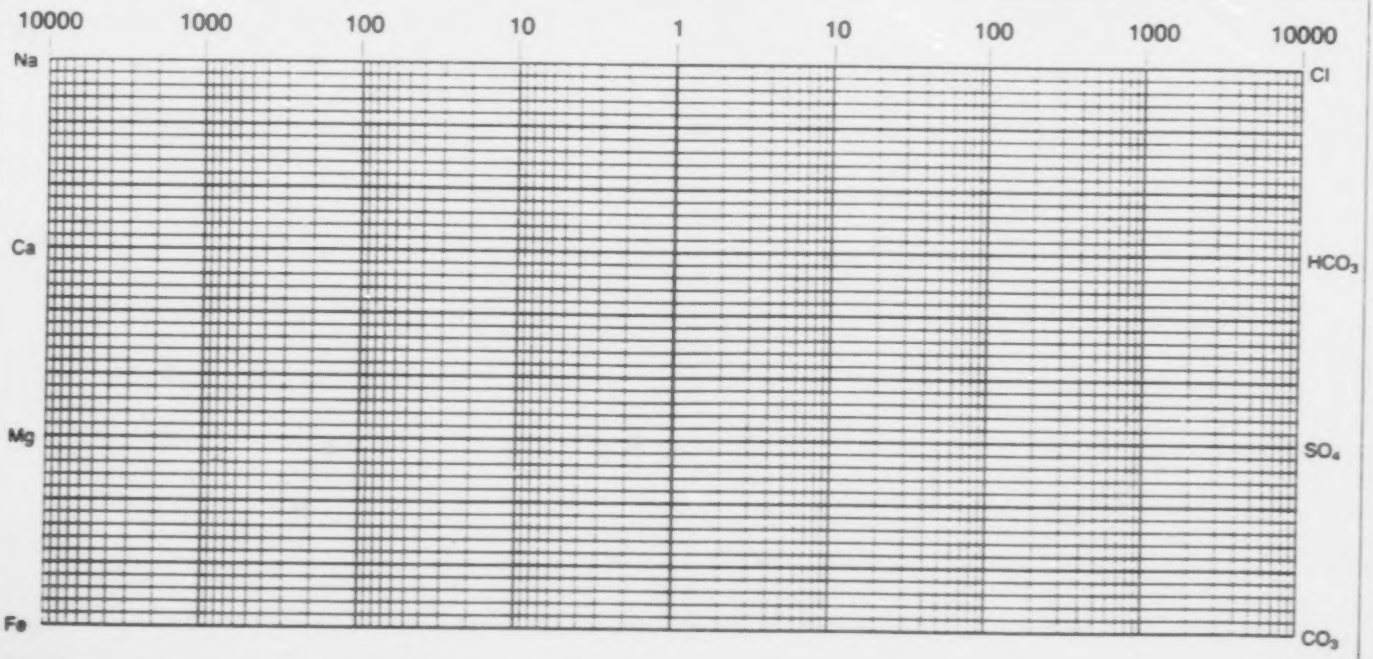
OBSERVED pH @ ____ °C ____
DENSITY @ 15°C, g/ml ____
RESISTIVITY @ 25°C, ohm - cm ____
CONDUCTIVITY @ 25°C, μs/cm ____
OIL AND GREASE, mg/L ____

TOTAL HARDNESS, mg/L ____
TOTAL DISSOLVED SOLIDS, mg/L ____
TOTAL SUSPENDED SOLIDS, mg/L ____
VOLATILE SUSPENDED SOLIDS, mg/L ____
FIXED SUSPENDED SOLIDS, mg/L ____

ION	CONCENTRATION	
	mg/L	meq/L
Na		
Ca		
Mg		
Fe		
K		
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl		
HCO_3		
SO_4		
CO_3		
OH		

LOGARITHMIC WATER PATTERN (meq/L)



0043-8508 Husky

Husky
(9)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION A10-35-49-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 19
DATE SAMPLED YEAR 1988 MONTH 08 DAY 19	SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

NO WATER

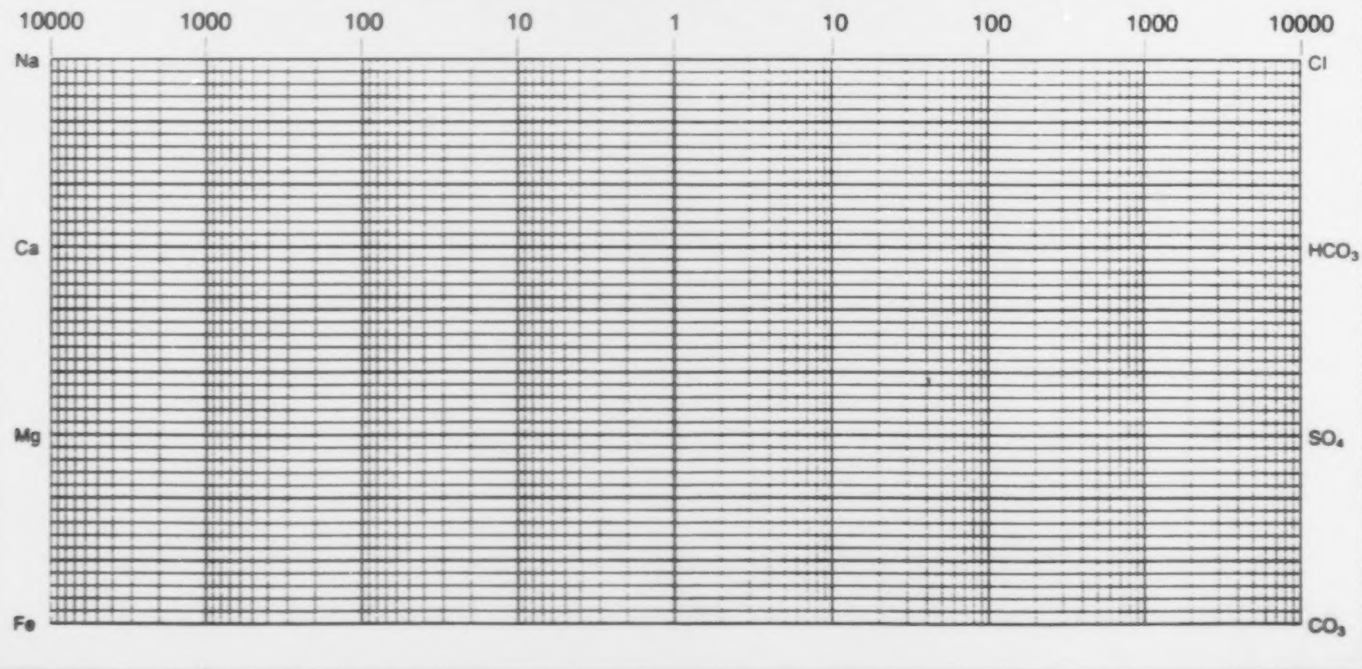
OBSERVED pH @ _____ °C ______________
DENSITY @ 15°C, g/ml ______________
RESISTIVITY @ 25°C, ohm - cm ______________
CONDUCTIVITY @ 25°C, μs/cm ______________
OIL AND GREASE, mg/L ______________

TOTAL HARDNESS, mg/L ______________
TOTAL DISSOLVED SOLIDS, mg/L ______________
TOTAL SUSPENDED SOLIDS, mg/L ______________
VOLATILE SUSPENDED SOLIDS, mg/L ______________
FIXED SUSPENDED SOLIDS, mg/L ______________

ION	CONCENTRATION	
	mg/L	meq/L
Na		
Ca		
Mg		
Fe		
K		
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl		
HCO_3		
SO_4		
CO_3		
OH		

LOGARITHMIC WATER PATTERN (meq/L)



Husky
(20)

HEAVY OIL LABORATORY WATER ANALYSIS

WELL NAME Standard Hill	LOCATION 10-35-49-22	FILE REFERENCE NUMBER DV/PDN:049
ANALYST I. Nowak/A. Rehman	DATE ANALYSED YEAR 1988 MONTH 09 DAY 12	LAB SAMPLE NUMBER
FORMATION	FIELD	DATE YEAR 1988 MONTH 09 DAY 19
DATE SAMPLED YEAR 1988 MONTH 08 DAY 20 / SAMPLED BY	SAMPLE CONTAINER(S) Plastic	PRESERVATIVE(S) None

NO WATER

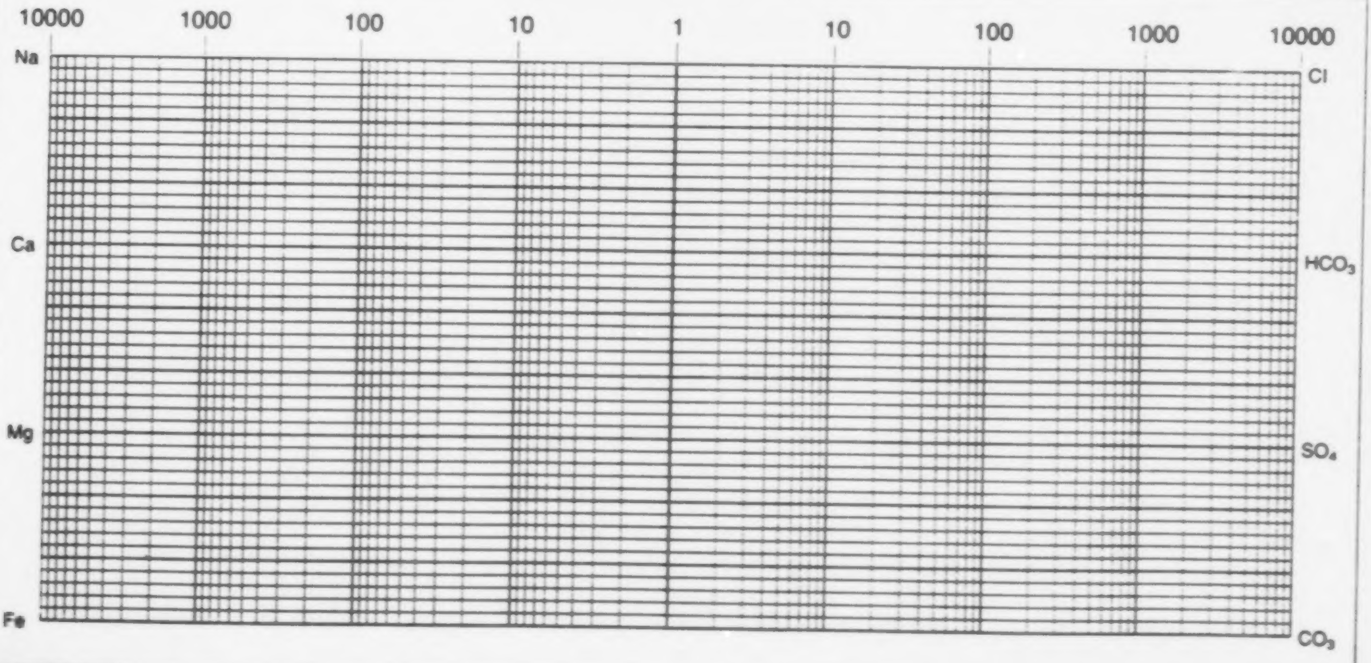
OBSERVED pH @ ____ °C ________________
DENSITY @ 15°C, g/ml ________________
RESISTIVITY @ 25°C, ohm - cm ________________
CONDUCTIVITY @ 25°C, μs/cm ________________
OIL AND GREASE, mg/L ________________

TOTAL HARDNESS, mg/L ________________
TOTAL DISSOLVED SOLIDS, mg/L ________________
TOTAL SUSPENDED SOLIDS, mg/L ________________
VOLATILE SUSPENDED SOLIDS, mg/L ________________
FIXED SUSPENDED SOLIDS, mg/L ________________

ION	CONCENTRATION	
	mg/L	meq/L
Na		
Ca		
Mg		
Fe		
K		
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl		
HCO_3		
SO_4		
CO_3		
OH		

LOGARITHMIC WATER PATTERN (meq/L)



0043 - 8508

Husky

HEAVY OIL LABORATORY WATER ANALYSIS

(8)

WELL NAME: Standard Hill
LOCATION: 10-35-49-22
FILE REFERENCE NUMBER: DV/PDN:053
ANALYST: I. Nowak/A. Rehman
DATE ANALYSED: YEAR 1988 MONTH 09 DAY 16
LAB SAMPLE NUMBER:
FORMATION:
FIELD:
DATE: YEAR 1988 MONTH 09 DAY 21
DATE SAMPLED: YEAR 1988 MONTH 08 DAY 21
SAMPLED BY:
SAMPLE CONTAINER(S): Plastic
PRESERVATIVE(S): None

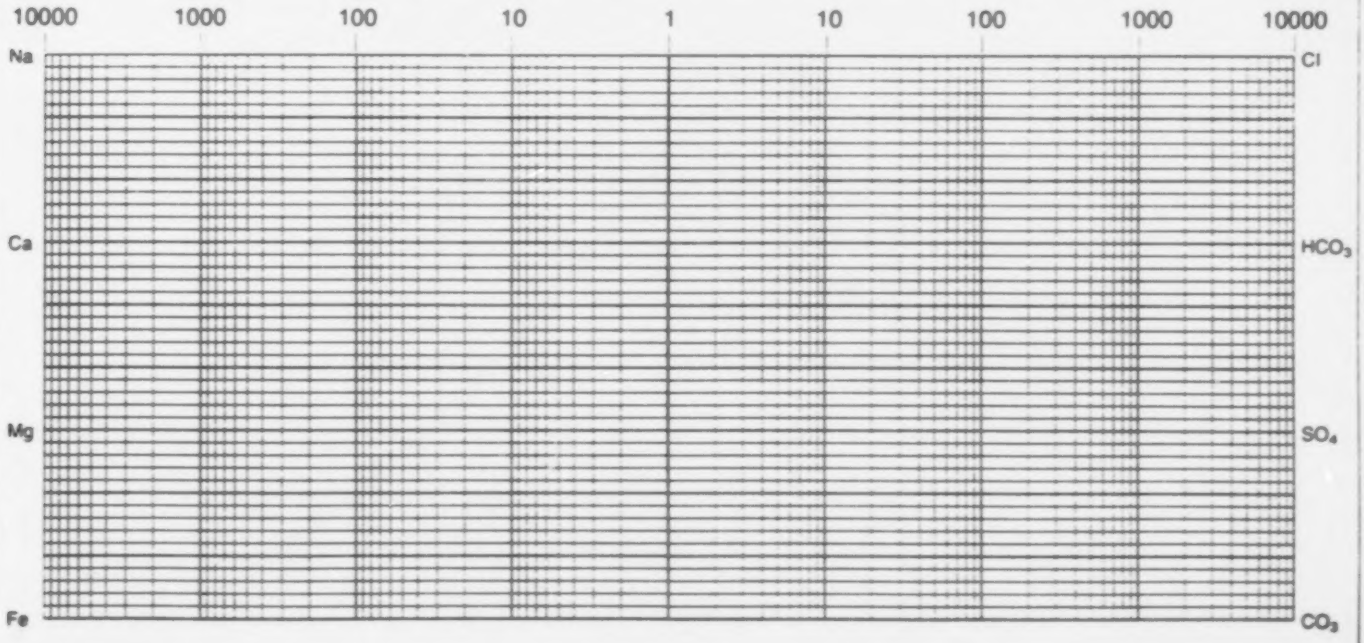
N O W A T E R

OBSERVED pH @ ____ °C ____
DENSITY @ 15°C, g/ml ____
RESISTIVITY @ 25°C, ohm - cm ____
CONDUCTIVITY @ 25°C, μs/cm ____
OIL AND GREASE, mg/L ____
TOTAL HARDNESS, mg/L ____
TOTAL DISSOLVED SOLIDS, mg/L ____
TOTAL SUSPENDED SOLIDS, mg/L ____
VOLATILE SUSPENDED SOLIDS, mg/L ____
FIXED SUSPENDED SOLIDS, mg/L ____

ION	CONCENTRATION	
	mg/L	meq/L
Na		
Ca		
Mg		
Fe		
K		
Ba		
Sr		
Mn		
Si		

ION	CONCENTRATION	
	mg/L	meq/L
Cl		
HCO_3		
SO_4		
CO_3		
OH		

LOGARITHMIC WATER PATTERN (meq/L)



0343 - 8509 Husky

MEMORANDUM

TO: L. Stehmeier

FROM: R. D. Dillen

SUBJECT: **STANDARD HILL -- WATER SAMPLES**

1988 SEPTEMBER 27

REF: **DV/PDN**-(PP)

The water analysis for samples taken on August 24th and 25th, 1988 are attached.

R. D. Dillen

R. D. Dillen

RDD:AGR:lef
c.c. S. Payne

Attachment

DV/PDN:054

NOVA / Husky Research Corporation Ltd.
RECEIVED
SEP 28 1988

STANDARD HILL

I. Nowak - Sept. 27, 1988

NO.	SAMPLE I.D.	DATE	SURFACE TENSION dyne/cm	pH	DENSITY at 15°C g/ml	CONDUCTIVITY at 25°C µs/cm	RESISTIVITY at 25°C ohm-cm
1	1-3-50-22	Aug. 24/88	70.4	7.30	1.0156	31 400	32
2	3-35-49-22	-- " --	69.9	7.46	1.0239	44 500	22
3	4-35-49-22	-- " --	70.0	7.31	1.0204	39 500	28
4	5-35-49-22	-- " --	66.1	7.39	1.0192	37 600	26
5	6-35-49-22	-- " --	66.9	7.32	1.0213	41 000	23
6	9-34-49-22	-- " --	68.9	7.15	1.0190	37 600	26
7	10-34-49-22	-- " --	67.7	7.20	1.0142	29 400	31
8	11 -35-49-22	-- " --	63.4	7.30	1.0166	33 400	30
9	12-35-49-22	-- " --	68.3	6.67	1.0194	38 300	25
10	16-34-49-22	-- " --	63.6	7.27	1.0176	35 700	30
11	A1-49-22	Aug. 25/88	57.2	7.44	1.0209	40 100	25
12	A4-25-49-22	-- " --	60.9	7.35	1.0184	37 400	26
13	A5-2-50-22	-- " --	63.7	7.20	1.0337	64 000	16
14	A5-35-49-22	-- " --	63.3	7.22	1.0198	39 900	23
15	A6-35-49-22	-- " --	67.1	7.33	1.0137	29 100	33
16	A9-34-49-22	-- " --	56.3	7.08	1.0173	35 900	27
17	A10-34-49-22	-- " --	66.0	7.34	1.0160	33 400	30
18	A10-35-49-22	-- " --	70.9	7.33	1.0172	33 500	30
19	A11-35-49-22	-- " --	63.7	7.69	1.0181	37 000	27
20	A12-35-49-22	-- " --	62.5	6.67	1.0229	45 000	22
21	A16-34-49-22	-- " --	55.9	7.14	1.0148	31 000	32

V/PDN:054

MEMORANDUM

TO: L. Stehmeier

1988 SEPTEMBER 26

FROM: R. D. Dillen

REF: **DV/PDN**-(PP)

SUBJECT: **STANDARD HILL -- WATER SAMPLES**

The results for two (2) batches of water samples taken August 26th and 27th, 1988 are attached.

R. D. Dillen

R. D. Dillen

RDD:AGR:lef
c.c. S. Payne

Attachment

DV/PDN:055

NOVA / Husky Research Corporation Ltd.
RECEIVED
OCT 3 -1988

STANDARD HILL -- Water Samples I. Nowak - Sept. 26, 1988

No.	SAMPLE I.D.	DATE	SURFACE TENSION dyne/cm	pH	DENSITY at 15°C g/ml	CONDUCTIVITY @ 25°C µs/cm	RESISTIVITY @ 25°C ohm-cm
1	A1-3-50-22	Aug. 26/88	60.1	7.16	1.0126	29 600	35
2	A3-35-49-22	-- " --	63.0	6.93	1.0015	9 750	110
3	A4-35-49-22	-- " --	69.8	7.17	1.0175	36 400	28
4	A5-2-50-22 Satellite	-- " --	72.2	7.46	1.0292	54 700	19
5	A5-35-49-22	-- " --	64.4	7.41	1.0052	23 700	44
6	A6-35-49-22	-- " --	66.3	7.40	1.0083	19 100	50
7	A8-34-49-22	-- " --	61.7	7.65	1.0313	58 300	17
8	A9-34-49-22	-- " --	64.0	6.96	1.0109	23 900	42
9	A10-34-49-22	-- " --	68.1	7.16	1.0050	12 680	80
10	A10-35-49-22	-- " --	NO WATER				
11	A11-35-49-22	-- " --	64.7	7.53	1.0094	21 000	48
12	A12-35-49-22	-- " --	58.5	6.93	1.0232	44 800	24
13	A16-34-49-22	-- " --	65.2	7.04	1.0054	13 800	79
14	A1-3-50-22	Aug. 27/88	68.7	6.98	1.0022	6 800	136
15	A3-35-49-22	-- " --	56.0	6.76	1.0031	8 600	116
16	A4-35-49-22	-- " --	67.8	7.20	1.0220	42 700	26
17	A5-2-50-22 Satellite	-- " --	62.9	7.87	1.0079	18 300	53
18	A5-35-49-22	-- " --	55.5	7.37	1.0133	27 800	36
19	A6-35-49-22	-- " --	63.3	7.39	1.0203	40 200	26
20	A9-34-49-22	-- " --	58.5	7.22	1.0217	42 200	24
21	A10-34-49-22	-- " --	56.0	6.84	1.0028	8 310	120
22	A11-35-49-22	-- " --	61.2	7.07	1.0037	10 100	100
23	A12-35-49-22	-- " --	56.3	6.59	1.0045	11 630	90
24	A16-34-49-22	-- " --	53.8	7.47	1.0070	16 300	64

DV/PDN:055

MEMORANDUM

TO: L. Stehmeier

FROM: R. D. Dillen

SUBJECT: **STANDARD HILL -- WATER SAMPLES**

1988 OCTOBER 03

REF: **DV/PDN-**(PP)

I have enclosed the results for water samples taken on August 28th, 1988.

R. D. Dillen

R. D. Dillen

RDD:IBN:lef
c.c. S. Payne

DV/PDN:088

NOVA / Husky Research Corporation Ltd.
RECEIVED
OCT - 5 1988

STANDARD HILL - WATER SAMPLES

I. NOWAK - September 26, 1988

NO.	SAMPLE I.D.	DATE	SURFACE TENSION dyne/cm	pH	DENSITY at 15°C g/ml	CONDUCTIVITY at 25°C µs/cm	RESISTIVITY at 25°C ohm-cm
1	A1-3-50-22	Aug. 28/88	63.4	6.87	1.0078	36 600	34
2	A3-35-49-22	-- " --	54.4	7.37	1.0217	43 300	26
3	A4-35-49-22	-- " --	59.8	7.05	1.0097	37 700	33
4	A5-2-50-22	-- " --	57.9	7.01	1.0252	48 800	24
5	A5-35-49-22	-- " --	54.3	6.87	1.0109	38 800	29
6	A6-35-49-22	-- " --	54.2	6.80	1.0056	33 400	36
7	A9-34-49-22	-- " --	57.4	6.81	1.0215	42 600	26
8	A10-34-49-22	-- " --	52.9	7.09	1.0082	29 200	38
9	A11-35-49-22	-- " --	56.7	7.04	1.0212	41 600	26
10	A12-35-49-22	-- " --	55.4	6.42	1.0103	28 500	38
11	A16-34-49-22	-- " --	55.7	6.90	1.0101	34 100	30

DV/PDN:088

MEMORANDUM

TO: L. Stehmeier

1988 OCTOBER 06

FROM: R. D. Dillen

REF: **DV/PDN-**(PP)

SUBJECT: **STANDARD HILL - WATER SAMPLES**

Standard Hill water samples taken on August 29 and 31, 1988, were analyzed. The results are listed below:

STANDARD HILL - WATER SAMPLES

I. Nowak - October 4, 1988

NO.	**SAMPLE I.D.**	**DATE**	**SURFACE TENSION dyne/cm**	**pH**	**DENSITY at 15°C g/ml**	**CONDUCTIVITY at 25°C µs/cm**	**RESISTIVITY at 25°C ohm-cm**
1	A1-3-50-22	Aug. 29/88	58.3	7.46	1.0161	36 000	31
2	A3-35-49-22	-- " --	62.0	7.47	1.0173	38 700	29
3	A4-35-49-22	-- " --	62.4	7.12	1.0218	43 600	23
4	A5-2-50-22 Satellite	-- " --	70.3	7.25	1.0241	47 100	22
5	A5-35-49-22	-- " --	55.2	7.11	1.0157	34 800	31
6.	A6-35-49-22	-- " --	54.9	7.05	1.0149	33 800	33
7.	A9-34-49-22	-- " --	66.8	7.06	1.0217	46 400	22
8.	A10-34-49-22	-- " --	54.8	7.39	1.0121	28 300	39
9.	A11-35-49-22	-- " --	58.4	7.19	1.0212	43 400	24
10.	A12-35-49-22	-- " --	55.9	6.64	1.0227	45 900	25
11.	A16-34-49-22	-- " --	49.9	7.10	1.0214	46 800	25
12.	A1-3-50-22	Aug. 31/88	59.2	7.40	1.0120	28 600	38
13.	A3-35-49-22	-- " --	66.8	7.19	1.0164	36 700	31
14.	A4-35-49-22	-- " --	64.7	6.87	1.0152	34 000	33
15.	A5-2-50-22 Satellite	-- " --	70.8	7.13	1.0259	51 000	20
16.	A5-35-49-22	-- " --	61.7	7.10	1.0211	42 500	47
17.	A6-35-49-22	-- " --	59.3	7.01	1.0171	35 500	32
18.	A9-34-49-22	-- " --	69.1	7.06	1.0083	20 500	52
19.	A10-34-49-22	-- " --	53.7	7.00	1.0213	45 600	26
20.	A11-35-49-22	-- " --	52.3	7.14	1.0212	44 200	25
21.	A12-35-49-22	-- " --	56.2	6.50	1.0175	37 000	29
22.	A16-34-49-22	-- " --	50.2	7.06	1.0162	34 600	33

R.D. Dillen

R. D. Dillen

RDD:IBN:lef
c.c. S. Payne
DV/PDN:066

APPENDIX D

BACTERIAL METABOLITE ANALYSES FROM PRODUCED WATERS

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NOVA-Husky Research Corporation

ANALYTICAL SERVICE REPORT

SERVICE REQUESTED BY:

NAME Les Stehmeier

PROJECT Standard Hill Field Test Baseline

PROJECT CODE 687-052

Date of Request:

Date of Report : Sept. 18, 1987

Labor Time :

REPORT DISTRIBUTION:

Les Stehmeier

Mark Gerlich

Rolf Saetre

SERVICE PROVIDED: Methanol, ethanol, iso-propanol, n-propanol, iso-butanol and n-butanol content in water.

RESULTS:

☒ See Attachment

COMMENTS AND RECOMMENDED ACTION:

☐ See Attachment

WORK PERFORMED BY: LOCAL 303 APPROVED BY:

Standard Hill Field Test Baseline - Alcohol Analysis

Chromatographic Conditions:

Column: 6 ft. x 2 mm. ID glass, 0.1% SP-1000 on 80/100 Carbopack C
Carrier: Nitrogen 20 mL/min.
Detector: FID
Oven Temp: $80^{\circ}C$ iso thermal

Calibration:

Methanol, ethanol and acetone were quantitated by peak height relative to 10 ppm volume standards. Linearity to 50 ppm was achieved.

The remainder of the components were standardized at 1, 10 and 50 ppm volume and calibrated at these levels using peak area. These components were linear in this range.

Sample Treatment:

Produced water samples were injected NEAT. The inoculated molasses samples were centrifuged and then filtered through a 0.5 mm membrane filter.

Comments:

The iso-butanol results for A6 and B523 in produced water inoculated with molasses are likely to be attributed to carry-over from previous injections. Iso-butanol appeared during blank water injections between the analysis of the molasses samples. The reason for this carry-over is unclear.

Standard Hill Field Test Baseline Data

1. August 19, 1987 Produced Water

Well #	Methanol ppm vol	Acetone ppm vol	Ethanol ppm vol	Iso-propanol ppm vol	Propanol ppm vol	Iso-butanol ppm vol	Butanol ppm vol
A5	7.2	14.5	<1	<1	<1	<1	<1
A7	1.1	<1	<1	<1	<1	<1	<1
A10	2.5	6.8	<1	<1	<1	<1	<1
A15	2.1	8.9	<1	<1	<1	<1	<1
B1	16.1	48	<1	<1	<1	<1	<1
B2	7.4	60	<1	<1	<1	<1	<1
B3	1.4	<1	<1	<1	<1	<1	<1
B6	14.0	101	<1	<1	<1	<1	<1
B8	2.2	5.9	<1	<1	<1	<1	<1

Standard Hill Field Test Baseline Data

2. August 24, 1987 Produced Water

Well #	Methanol ppm vol	Acetone ppm vol	Ethanol ppm vol	Iso-propanol ppm vol	Propanol ppm vol	Iso-butanol ppm vol	Butanol ppm vol
A5	<1	<1	<1	<1	<1	<1	<1
A7	<1	<1	<1	<1	<1	<1	<1
A10	3.6	30.0	<1	<1	<1	<1	<1
A15	<1	<1	<1	<1	<1	<1	<1
B1	<1	<1	<1	<1	<1	<1	<1
B2	37.0	183	<1	<1	<1	<1	<1
B3	37.0	281	<1	<1	<1	<1	<1
B6	1.8	9.0	<1	<1	<1	<1	<1
B8	9.5	60	<1	<1	<1	<1	<1

Standard Hill Field Test Baseline Data

3. August 26, 1987 Produced Water

Well #	Methanol ppm vol	Acetone ppm vol	Ethanol ppm vol	Iso-propanol ppm vol	Propanol ppm vol	Iso-butanol ppm vol	Butanol ppm vol
A5	2.8	7.4	<1	<1	<1	<1	<1
A7	<1	<1	<1	<1	<1	<1	<1
A10	1.5	3.0	<1	<1	<1	<1	<1
A15	<1	<1	<1	<1	<1	<1	<1
B1	<1	1.2	<1	<1	<1	<1	<1
B2	<1	<1	<1	<1	<1	<1	<1
B3	83	7.9	<1	1.9	<1	<1	<1
B6	1.5	3.3	<1	<1	<1	<1	<1
B8	1.5	<1	<1	<1	<1	<1	<1

Standard Hill Field Test Baseline Data

4. Produced Water Inolculated with Molasses

Well #	Methanol ppm vol	Acetone ppm vol	Ethanol ppm vol	Iso-propanol ppm vol	Propanol ppm vol	Iso-butanol ppm vol	Butanol ppm vol
A1	1.6	<1	303	3.3	13.5	<1	6
A2	1.4	1.3	2260	4.9	16.7	<1	<1
A3	6.3	1.0	142	3.1	26.2	<1	20.5
A5	2.2	1.0	331	2.5	27.9	<1	3.8
A6	1.5	1.5	144	3.2	28.1	2.1	20.4
A7	1.6	1.5	505	<1	1.4	<1	<1
A10	1.8	2.4	12.8	<1	3.8	<1	<1
A15	1.1	2.2	73	1.7	26.7	<1	1.5
B8	1.4	2.2	30	<1	1.6	<1	<1
B523	3.5	4.6	1430	14.6	<1	1.2	<1

NOVA-Husky Research Corporation

ANALYTICAL SERVICE REPORT

SERVICE REQUESTED BY:

NAME LES STEHMEIER

PROJECT STANDARD HILL FIELD TEST BASELINE

PROJECT CODE 687-013

Date of Request:

Date of Report : October 1, 1987

Labor Time : 15 hrs.

REPORT DISTRIBUTION:

Les Stehmeier

Mark Gerlich

Rolf Saetre

SERVICE PROVIDED:

NON-VOLATILE ACIDS IN PRODUCED WATER

RESULTS: ☒ See Attachment

COMMENTS AND RECOMMENDED ACTION: ☐ See Attachment

WORK PERFORMED BY: Mark Gerlich **LOCAL** 303 **APPROVED BY:**

STANDARD HILL FIELD TEST BASELINE -- NON-VOLATILE ACIDS

CHROMATOGRAPHIC CONDITIONS

Column: 6 ft x 2 mm ID glass, 10% SP-1000/1% H_3PO_4
on 100/120 Chromosorb W AW
Carrier: Nitrogen, 20 mL/min
Detector: Flame Ionization
Oven Temperature: 120°C

CALIBRATION:

Standards of 10, 100 and 1000 mg/L of each non-volatile acid were analyzed.

Calibration was achieved with standards of 10, 100 and 1000 mg/L using peak heights. The lower level of quantitation for pyruvic acid is 50 mg/L since it elutes high off the shoulder of the reagent peak.

RESULTS:

All 27 produced water samples from August 19, August 24 and August 26 contained less than 50 mg/L pyruvic acid and less than 10 mg/L of all other components. The results for the produced water samples inoculated with molasses are found in Table 1.

STANDARD HILL FIELD TEST BASELINE -- NON-VOLATILE ACIDS

TABLE 1: PRODUCED WATER INOCULATED WITH MOLASSES

SAMPLE ID	PYRUVIC ACID	LACTIC ACID	OXALIC/ OXALACETIC ACIDS	METHYL MALONIC ACID	MALONIC ACID	FUMARIC ACID	SUCCINIC ACID
A1	<50	500	21	<10	<10	<10	18
A2	<50	2400	27	<10	15	190	530
A3	<50	550	55	<10	<10	<10	47
A5	<50	300	19	<10	14	<10	18
A6	<50	650	<10	<10	<10	<10	41
A7	<50	850	<10	<10	<10	<10	41
A10	<50	1200	21	<10	<10	<10	<10
A15	<50	2900	<10	<10	<10	<10	<10
B8	<50	4500	21	<10	<10	<10	<10
B523	<50	9500	94	<10	51	14	36

All results in mg/L.

NOVA-Husky Research Corporation

ANALYTICAL SERVICE REPORT

SERVICE REQUESTED BY:

NAME	LES STEHMEIER	Date of Request:	
PROJECT	STANDARD HILL FIELD TEST BASELINE	Date of Report :	September 25/87
PROJECT CODE	687-031	Labor Time :	19 hrs

REPORT DISTRIBUTION:

LES STEHMEIER
MARK GERLICH
ROLF SAETRE

SERVICE PROVIDED:

VOLATILE ACID IN PRODUCED WATER

RESULTS: ☒ See Attachment

COMMENTS AND RECOMMENDED ACTION: ☐ See Attachment

WORK PERFORMED BY: MARK GERLICH LOCAL 303 APPROVED BY:

STANDARD HILL FIELD TEST BASELINE -- VOLATILE ACID ANALYSIS

CHROMATOGRAPHIC CONDITIONS:

Column: 6 ft x 2 mm ID glass, 10% SP-1000/1% H_3PO_4 on 100/120 mesh Chromosorb W AW
Carrier: Nitrogen, 20 mL/min
Detector: FID
Oven Temp: 140°C hold for 8 minutes
140°C to 165°C at 20°C/minute
165°C hold for 11 minutes

CALIBRATION:

A three level calibration in the range of 5 to 1500 ppm volume was performed for all components except acetic acid. Acetic acid was calibrated at 2 levels (24 and 601 ppm) since the second dilution of the standard was too low for accurate quantitation.

All components were calibrated using peak area except iso-caproic and caproic acids since these peaks eluted during the baseline increase due to the temperature program. Peak height was used for these components.

SAMPLE TREATMENT:

The samples and standards were acidified and extracted into ether. A 3 μL aliquot of the ether extract was injected into the gas chromatograph.

STANDARD HILL FIELD TEST BASELINE DATA

1. August 19, 1987 Produced Water

WELL #	ACETIC ACID	PROPIONIC ACID	ISO-BUTYRIC ACID	BUTYRIC ACID	ISO-VALERIC ACID	VALERIC ACID	ISO-CAPROIC ACID	CAPROIC ACID	HEPTANOIC ACID
A5	<10	<1	<1	<1	<1	<1	<1	<1	<1
A7	25	<1	<1	<1	<1	<1	<1	<1	<1
A10	<10	<1	<1	<1	<1	<1	<1	<1	<1
A15	<10	<1	<1	<1	<1	<1	<1	<1	<1
B1	<10	<1	<1	<1	<1	<1	<1	1.9	3.4
B2	<10	<1	<1	<1	<1	<1	<1	<1	<1
B3	<10	<1	<1	<1	<1	<1	<1	<1	<1
B6	<10	<1	<1	<1	<1	<1	<1	<1	<1
B8	<10	<1	<1	<1	<1	<1	<1	<1	<1

All results in ppm volume.

STANDARD HILL FIELD TEST BASELINE DATA

2. August 24, 1987 Produced Water

WELL #	ACETIC ACID	PROPIONIC ACID	ISO-BUTYRIC ACID	BUTYRIC ACID	ISO-VALERIC ACID	VALERIC ACID	ISO-CAPROIC ACID	CAPROIC ACID	HEPTANOIC ACID
A5	<10	<1	<1	<1	<1	<1	<1	<1	<1
A7	17	<1	<1	<1	<1	<1	<1	<1	<1
A10	<10	<1	<1	<1	<1	<1	<1	<1	<1
A15	<10	<1	<1	<1	<1	<1	<1	<1	<1
B1	<10	<1	<1	<1	<1	<1	<1	<1	1.4
B2	<10	<1	<1	<1	<1	<1	<1	<1	<1
B3	<10	<1	<1	<1	<1	<1	<1	<1	<1
B6	<10	<1	<1	<1	<1	<1	<1	<1	<1
B8	<10	<1	<1	<1	<1	<1	<1	<1	<1

All results in ppm volume.

STANDARD HILL FIELD TEST BASELINE DATA

3. August 26, 1987 Produced Water

WELL #	ACETIC ACID	PROPIONIC ACID	ISO-BUTYRIC ACID	BUTYRIC ACID	ISO-VALERIC ACID	VALERIC ACID	ISO-CAPROIC ACID	CAPROIC ACID	HEPTANOIC ACID
A5	<10	<1	<1	<1	<1	<1	<1	<1	<1
A7	<10	<1	<1	<1	<1	<1	<1	<1	<1
A10	<10	<1	<1	<1	<1	<1	<1	<1	<1
A15	<10	<1	<1	<1	<1	<1	<1	<1	<1
B1	<10	<1	<1	<1	<1	<1	<1	<1	<1
B2	<10	<1	<1	<1	<1	<1	<1	<1	<1
B3	<10	<1	<1	<1	<1	<1	<1	<1	<1
B6	<10	<1	<1	<1	<1	<1	<1	<1	<1
B8	<10	<1	<1	<1	<1	<1	<1	<1	<1

All results in ppm volume.

STANDARD HILL FIELD TEST BASELINE DATA

4. Produced Water Inoculated with Molasses

WELL #	ACETIC ACID	PROPIONIC ACID	ISO-BUTYRIC ACID	BUTYRIC ACID	ISO-VALERIC ACID	VALERIC ACID	ISO-CAPROIC ACID	CAPROIC ACID	HEPTANOIC ACID
A1	1900	130	11	260	42	<1	<1	<1	5.5
A2	890	12	127	26	1.2	<1	<1	<1	3.1
A3	2700	89	20	860	82	13	15	<1	1.2
A5	2500	230	9.1	270	37	1.7	13	<1	<1
A6	2100	84	15	540	57	3.6	12	<1	<1
A7	1600	210	15	610	53	4.9	14	<1	<1
A10	510	143	<1	47	4.3	<1	<1	<1	<1
A15	1400	260	4.7	165	31	<1	22	<1	<1
B8	390	5.1	<1	23	4.7	<1	<1	<1	<1
B523	2600	5.1	<1	27	<1	<1	<1	<1	<1

All results in ppm volume

NOVA-Husky Research Corporation

ANALYTICAL SERVICE REPORT

SERVICE REQUESTED BY:

NAME Les Stehmeier

PROJECT Standard Hill Field Test

PROJECT CODE 687 - 391

Date of Request:

Date of Report : Oct. 5, 1987

Labor Time : 8 hrs.

REPORT DISTRIBUTION:

Les Stehmeier

Rolf Saetre

Mark Gerlich

SERVICE PROVIDED:

Sugar analysis in B523 molasses culture.

RESULTS: ☒ See Attachment

COMMENTS AND RECOMMENDED ACTION: ☐ See Attachment

WORK PERFORMED BY: Mark Gerlich **LOCAL** 303 **APPROVED BY:**

Standard Hill Field Test Baseline Data - Sugars

[illegible]

The results of the analysis of the B523 molasses culture is listed in Table 1. As agreed upon, analysis of the 3 remaining produced water samples will not be done, since the detection limit of the method at this time is well above the expected concentrations in the samples. The lack of sensitivity is most likely due to the larger dead volume in the FID of the Hewlett Packard gas chromatograph in comparison to the Perkin Elmer G.C. previously used for this analysis.

This method was calibrated using 'Sigma' trimethylsilyl derivatives of the sugars. These were diluted in sylon reagent. The accuracy is limited mostly by the purity of the standards. B-glucose is 95% pure and fructose is 90 - 95% pure. Absolute purity was assumed for all standards. The sample was prepared using the procedure for sugar analysis as outlined in NHRC Report #183.

NOVA HUSKY
RESEARCH
CORPORATION

memorandum

DATE: October 5, 1988

TO: Les Stehmeier

FROM: Mark Gerlich

RE: **STANDARD HILL ALCOHOL ANALYSES - 1988**

Standard Hill produced water samples taken between August 15, 1988 and September 8, 1988 have been analyzed for alcohols. The procedure used is almost identical to the one described in my memo sent to you on September 18, 1987. Better sensitivity was achieved with the use of a narrower FID jet. All the results are found in Tables 1-13 organized by well identifier.

The results for iso-propanol must be evaluated with caution since contamination of approximately 0.4 mg/L was observed in some blanks due to a batch of new sample vial seals used for the analyses. The supplier of the seals was contacted and subsequently confirmed that iso-propanol is used in the manufacturing of these seals.

The molasses-containing samples of produced water taken from wells A3-2 and A15-1 on August 1 at 04:30 were also analyzed for alcohols. No alcohols were detected in these solutions.

A single sample taken from well A8-34 on August 26 contained 3 mg/L of methanol, 6.0 mg/L of ethanol and 1.5 mg/L of acetone.

M. G.

/shb
Encl.

cc: Rolf Saetre

TABLE 1: ALCOHOL ANALYSES FROM WELL A1-3

DATE		CONCENTRATION (mg/L)						
		Methanol	Ethanol	Acetone	Iso-propanol	N-propanol	Iso-butanol	N-butanol
August	15	<1	<.1	<.1	<.1	<.1	<.5	<.5
	17	<1	11.0	<.1	<.1	1.2	<.5	<.5
	18	<1	11.5	<.1	<.1	1.4	<.5	0.9
	19	<1	16.2	0.5	<.1	1.8	<.5	1.3
	20	<1	14.9	<.1	<.1	1.9	<.5	1.2
	21	<1	13.2	<.1	<.1	1.7	<.5	1.2
	23	<1	15.1	<.1	<.1	2.8	<.5	1.8
	24	<1	20.9	<.1	<.1	3.3	<.5	2.1
	25	<1	17.3	<.1	<.1	2.5	<.5	1.7
	26	*	5.3	0.3	.2	1.7	<.5	1.4
	27	*	10.5	<.1	.6	1.9	<.5	1.3
	28	*	8.2	<.1	.6	1.5	<.5	1.4
	29	*	5.3	<.1	.1	1.3	<.5	1.2
	31	*	7.5	<.1	.1	2.3	<.5	1.7
Sept.	5	*	5.4	<.1	.6	2.2	<.5	1.0
	8	*	4.2	<.1	<.1	1.5	<.5	0.8

* A large unidentified peak masked the methanol peak.

Table 1 Sugar Analysis in B523 Molasses Culture

Sugar	**Concentration (mg/L)**
Fructose	61,000
α-glucose	129,000
β-glucose	160,000
Sucrose	151,000

TABLE 2: ALCOHOL ANALYSES FROM WELL A16-34

DATE		CONCENTRATION (mg/L)						
		Methanol	Ethanol	Acetone	Iso-propanol	N-propanol	Iso-butanol	N-butanol
August	18	<1	12	<.1	<.1	1.2	<.5	0.8
	19	<1	9.4	<.1	0.7	1.1	<.5	0.8
	20	<1	9.1	<.1	0.5	0.9	<.5	0.8
	21	<1	9.5	1.2	2.0	1.9	<.5	1.4
	23	<1	7.9	<.1	0.6	1.3	<.5	1.0
	24	<1	12.9	<.1	0.6	1.2	<.5	1.4
	25	<1	8.1	<.1	0.4	1.1	<.5	1.2
	26	<1	7.5	<.1	<.1	1.3	<.5	1.3
	27	<1	4.0	<.1	<.1	1.0	<.5	1.0
	28	<1	1.6	<.1	<.1	0.7	<.5	0.6
	29	<1	2.4	<.1	<.1	0.8	<.5	0.6
	31	<1	0.1	<.1	<.1	0.5	<.5	0.6
Sept.	5	<1	3.6	<.1	<.1	1.3	<.5	0.7
	8	<1	3.0	<.1	0.4	1.3	<.5	<.5

TABLE 3: ALCOHOL ANALYSES FROM WELL A9-34

DATE		CONCENTRATION (mg/L)						
		Methanol	Ethanol	Acetone	Iso-propanol	N-propanol	Iso-butanol	N-butanol
August	15	<1	<.1	0.4	<.1	<.1	<.5	<.5
	17	<1	23.0	0.3	<.1	2.0	<.5	0.9
	18	<1	17.0	0.1	<.1	1.5	<.5	0.9
	19	4	17.0	<.1	0.5	1.9	<.5	1.1
	20	<1	10.1	<.1	0.3	1.2	<.5	1.2
	21	<1	8.0	<.1	0.5	1.0	<.5	1.1
	23	<1	13.7	<.1	2.3	3.1	<.5	1.4
	24	<1	16.3	<.1	0.8	2.9	<.5	1.9
	25	<1	10.5	<.1	0.4	1.9	<.5	1.5
	26	<1	9.0	<.1	<.1	2.5	<.5	1.6
	27	<1	2.8	<.1	<.1	1.4	<.5	1.3
	28	<1	4.8	<.1	<.1	2.0	<.5	1.3
	29	<1	6.7	<.1	<.1	2.6	<.5	1.5
	31	<1	4.6	<.1	<.1	2.6	<.5	1.6
Sept.	5	<1	3.8	<.1	<.1	1.7	<.5	0.9
	8	<1	1.9	<.1	0.4	2.0	<.5	0.9

TABLE 4: ALCOHOL ANALYSES FROM WELL A10-34

DATE		CONCENTRATION (mg/L)						
		Methanol	Ethanol	Acetone	Iso-propanol	N-propanol	Iso-butanol	N-butanol
August	15	<1	<.1	0.9	3.7	<.1	<.5	<.5
	16	<1	18.0	0.1	<.1	1.3	<.5	0.8
	17	<1	35.0	0.1	0.4	3.2	<.5	1.1
	18	<1	22.0	0.2	0.1	2.2	<.5	1.2
	19	<1	13.6	<.1	5.9	1.9	<.5	1.1
	20	<1	11.6	<.1	1.1	1.4	<.5	1.0
	21	<1	6.9	<.1	0.5	1.0	<.5	1.2
	23	<1	11.4	<.1	1.0	1.9	<.5	1.5
	24	<1	12.4	<.1	0.9	1.9	<.5	1.3
	25	<1	14.4	<.1	0.6	2.4	<.5	1.9
	26	<1	7.7	<.1	<.1	1.9	<.5	1.3
	27	<1	6.6	<.1	<.1	2.0	<.5	1.3
	28	<1	6.9	<.1	<.1	2.3	<.5	1.3
	29	<1	5.3	<.1	<.1	2.3	<.5	1.3
	31	<1	5.3	<.1	<.1	2.5	<.5	1.6
Sept.	5	<1	4.0	<.1	0.3	2.0	<.5	1.0
	8	<1	3.3	<.1	<.1	1.6	<.5	0.8

TABLE 5: ALCOHOL ANALYSES FROM WELL A5-02

DATE		CONCENTRATION (mg/L)						
		Methanol	Ethanol	Acetone	Iso-propanol	N-propanol	Iso-butanol	N-butanol
August	11	<1	<.1	<.1	<.1	<.1	<.5	<.5
	12	<1	<.1	<.1	<.1	<.1	<.5	<.5
	13	<1	<.1	<.1	<.1	<.1	<.5	<.5
	14	620	*	<.1	6.7	<.1	<.5	<.5
	15	<1	<.1	<.1	<.1	<.1	<.5	<.5
	16	2	<.1	<.1	<.1	<.1	<.5	<.5
	17	3	2.4	<.1	<.1	<.1	<.5	<.5
	18	1	1.8	<.1	<.1	<.1	<.5	<.5
	20	<1	<.1	<.1	0.5	<.1	<.5	<.5
	21	<1	7.8	<.1	0.4	0.4	<.5	<.5
	23	<1	<.1	<.1	0.5	<.1	<.5	<.5
Sept.	5	<1	5.7	<.1	<.1	1.3	<.5	<.5
	8	<1	5.5	<.1	0.5	1.2	<.5	<.5

* Ethanol was masked by large methanol (?) peak.

TABLE 6: ALCOHOL ANALYSES FROM A5-02 SATELLITE

DATE	CONCENTRATION (mg/L)						
	Methanol	Ethanol	Acetone	Iso-propanol	N-propanol	Iso-butanol	N-butanol
August 10	<1	<.1	0.2	<.1	<.1	<.5	<.5
11	<1	<.1	0.2	<.1	<.1	<.5	<.5
12	<1	<.1	<.1	<.1	<.1	<.5	<.5
13	<1	<.1	<.1	<.1	<.1	<.5	<.5
14	<1	<.1	<.1	<.1	<.1	<.5	<.5
15	<1	<.1	<.1	0.5	<.1	<.5	<.5
16	<1	1.2	<.1	<.1	<.1	<.5	<.5
19	<1	7.2	<.1	2.8	0.6	<.5	<.5
20	<1	13.2	<.1	1.2	0.7	<.5	<.5
21	<1	<.1	<.1	0.4	<.1	<.5	<.5
23	<1	6.2	<.1	0.6	0.7	<.5	<.5
24	<1	10.8	<.1	2.5	2.0	<.5	<.5
25	<1	5.6	<.1	0.5	0.7	<.5	<.5
26	22	8.4	3.1	1.2	0.6	<.5	0.6
27	14	9.0	<.1	3.6	4.1	<.5	<.5
28	14	9.3	<.1	1.2	1.5	<.5	2.9
29	11	11.3	<.1	0.8	2.2	<.5	0.6
31	7	7.5	<.1	<.1	1.1	<.5	1.6

TABLE 7: ALCOHOL ANALYSES FROM WELL A3-35

DATE	CONCENTRATION (mg/L)						
	Methanol	Ethanol	Acetone	Iso-propanol	N-propanol	Iso-butanol	N-butanol
August 15	<1	<.1	<.1	<.1	<.1	<.5	<.5
16	<1	15.3	<.1	<.1	1.0	<.5	1.1
17	<1	12.1	0.3	<.1	0.9	<.5	1.0
18	<1	13.5	1.3	<.1	1.1	<.5	1.1
19	<1	14.0	<.1	<.1	1.4	<.5	1.4
20	<1	13.4	<.1	<.1	0.8	<.5	<.5
21	<1	8.4	<.1	<.1	1.3	<.5	1.4
23	<1	12.8	0.2	0.1	1.6	<.5	1.6
24	<1	14.0	<.1	<.1	2.0	<.5	1.7
25	<1	23.8	0.2	<.1	2.7	<.5	2.3
26	<1	15.0	<.1	<.1	2.3	<.5	0.7
27	<1	20.6	<.1	0.4	2.6	<.5	2.3
28	<1	15.1	<.1	<.1	2.3	<.5	1.9
29	<1	14.3	<.1	<.1	2.5	<.5	1.9
31	<1	13.9	<.1	0.3	2.6	<.5	2.1
Sept. 5	<1	8.1	<.1	<.1	2.2	<.5	1.3
8	<1	4.9	<.1	<.1	2.7	<.5	1.0

TABLE 9: ALCOHOL ANALYSES FROM WELL A5-35

DATE		CONCENTRATION (mg/L)						
		Methanol	Ethanol	Acetone	Iso-propanol	N-propanol	Iso-butanol	N-butanol
August	15	<1	<.1	<.1	<.1	<.1	<.5	<.5
	16	<1	10.9	0.2	<.1	0.7	<.5	<.5
	17	<1	9.8	<.1	<.1	0.6	<.5	<.5
	18	<1	9.9	0.5	<.1	0.7	<.5	0.8
	19	<1	11.0	<.1	<.1	0.7	<.5	0.9
	20	<1	10.0	<.1	<.1	0.8	<.5	0.9
	21	<1	7.0	<.1	0.1	0.6	<.5	0.8
	23	<1	8.5	<.1	<.1	1.0	<.5	1.1
	24	<1	14.3	<.1	0.2	1.5	<.5	1.5
	25	<1	10.3	<.1	<.1	1.2	<.5	1.4
	26	<1	9.1	<.1	<.1	1.1	<.5	1.5
	27	<1	5.6	<.1	0.3	1.2	<.5	1.3
	28	<1	4.3	<.1	<.1	1.3	<.5	1.2
	29	<1	2.7	<.1	0.2	1.0	<.5	0.9
	31	<1	<.5	<.1	0.2	<.1	<.5	<.5
Sept.	5	<1	4.1	<.1	0.4	1.4	<.5	<.5
	8	<1	3.5	<.1	0.4	1.1	<.5	<.5

TABLE 10: ALCOHOL ANALYSES FROM WELL A6-35

DATE		CONCENTRATION (mg/L)						
		Methanol	Ethanol	Acetone	Iso-propanol	N-propanol	Iso-butanol	N-butanol
August	15	88	460	*	16.1	5.1	<.5	<.5
	16	<1	12.2	<.1	0.5	0.5	<.5	<.5
	17	<1	10.5	<.1	<.1	0.5	<.5	<.5
	18	<1	8.8	0.5	<.1	0.6	<.5	<.5
	19	<1	6.9	<.1	<.1	0.4	<.5	<.5
	20	<1	8.9	<.1	<.1	0.5	<.5	<.5
	21	<1	5.6	<.1	<.1	0.4	<.5	<.5
	23	<1	7.5	< 1	<.1	0.7	<.5	<.5
	24	<1	9.3	<.1	<.1	0.9	<.5	1.2
	25	<1	13.2	<.1	<.1	1.3	<.5	1.0
	26	<1	0.3	0.3	0.9	0.3	<.5	<.5
	27	<1	7.7	<.1	<.1	1.2	<.5	1.1
	28	<1	0.1	<.1	<.1	0.2	<.5	<.5
	29	<1	1.2	<.1	0.2	1.5	<.5	0.8
	31	<1	1.5	<.1	0.2	0.8	<.5	0.9
Sept.	5	<1	6.7	<.1	<.1	1.3	<.5	<.5
	8	<1	4.4	<.1	<.1	1.7	<.5	<.5

TABLE 11: ALCOHOL ANALYSES FROM WELL A10-35

DATE	**CONCENTRATION (mg/L)**						
	Methanol	Ethanol	Acetone	Iso-propanol	N-propanol	Iso-butanol	N-butanol
August 16	<1	<.1	<.1	<.1	<.1	<.5	<.5
17			------- No Water Present -------				
19			------- No Water Present -------				
21			------- No Water Present -------				
25	<1	11.7	<.1	<.1	1.8	<.5	2.0
26			------- No Water Present -------				

TABLE 12: ALCOHOL ANALYSES FROM WELL A11-35

DATE		CONCENTRATION (mg/L)						
		Methanol	Ethanol	Acetone	Iso-propanol	N-propanol	Iso-butanol	N-butanol
August	15	<1	<.1	<.1	<.1	<.1	<.5	<.5
	18	<1	5.3	<.1	<.1	0.3	<.5	<.5
	19	<1	8.8	<.1	<.1	0.4	<.5	<.5
	20	<1	5.0	<.1	<.1	0.3	<.5	<.5
	21	<1	6.1	<.1	<.1	0.2	<.5	<.5
	23	<1	6.0	<.1	<.1	0.4	<.5	<.5
	24	<1	7.5	<.1	<.1	0.7	<.5	<.5
	25	<1	2.8	<.1	<.1	0.6	<.5	0.6
	26	<1	3.9	<.1	0.3	0.4	<.5	<.5
	27	<1	4.4	<.1	0.3	0.6	<.5	<.5
	28	<1	3.9	<.1	0.2	0.4	<.5	<.5
	29	<1	2.7	<.1	0.3	0.3	<.5	<.5
	31	<1	2.1	<.1	0.1	0.4	<.5	<.5
Sept.	5	<1	4.8	<.1	<.1	0.7	<.5	<.5
	8	<1	4.9	<.1	<.1	0.8	<.5	<.5

TABLE 13: ALCOHOL ANALYSES FROM WELL A12-35

DATE		CONCENTRATION (mg/L)						
		Methanol	Ethanol	Acetone	Iso-propanol	N-propanol	Iso-butanol	N-butanol
August	15	*	<.1	0.7	3.7	<.1	<.5	<.5
	19	*	46.5	<.5	3.5	3.3	<.5	<.5
	20	*	54.3	<.5	5.7	5.2	<.5	1.6
	21	*	22.1	<.5	0.8	2.0	<.5	1.3
	23	*	20.4	<.5	1.3	2.1	<.5	1.1
	24	*	79	2.9	2.4	6.8	<.5	2.1
	25	*	62	<.5	4.5	5.7	<.5	2.3
	26	*	56	<10	5.6	10.1	<.5	5.6
	27	*	53	<10	1.3	7.0	<.5	3.6
	28	*	44	<10	0.8	5.6	<.5	2.4
	29	*	44	<10	1.8	6.4	<.5	3.1
	31	*	54	16	<.5	9.4	<.5	3.6
Sept.	5	*	10.2	<.1	0.3	4.0	<.5	2.1
	8	*	4.6	<.1	0.4	3.4	<.5	1.5

* A large unidentified peak masked the methanol peak.

NOTE: Varying component sensitivity is due to interferences from neighboring peaks.

NOVA HUSKY
RESEARCH
CORPORATION

memorandum

DATE: October 13, 1988

TO: Les Stehmeier

FROM: Mark Gerlich

RE: **STANDARD HILL PRODUCED WATER ANALYSES -- VOLATILE AND NON-VOLATILE ACIDS**

The samples selected for volatile and non-volatile acid analysis have been completed. Chromatographic conditions were the same as those used for the 1987 Standard Hill field test baseline. The sensitivity achieved for the volatile acid analyses was comparable to the analyses from last year, however, for the non-volatile acid analyses, the sensitivity decreased by a factor of approximately 10. At this time, the reason for this is unclear. The sensitivity is estimated at 100 mg/L for each component.

Results for the non-volatile acid analyses are found in Table 1 and the volatile acid analyses in Tables 2 through 10.

M.G.

/shb
Encl.

cc. Rolf Saetre

TABLE 1: NON-VOLATILE ACID ANALYSES

SAMPLE IDENTIFICATION	SAMPLE DATE	CONCENTRATION (mg/L)	
		LACTIC ACID	SUCCINIC ACID
A 3-2	August 1	3.7×10^3	66
A15-2	August 1	2.2×10^3	37
A6-35	August 15	4.0×10^3	64

TABLE 3: VOLATILE ACID ANALYSES FROM WELL A1-3

SAMPLE DATE		Acetic Acid	Propionic Acid	Iso-butyric Acid	Butyric Acid	Iso-Valeric Acid	Valeric Acid	Iso-Caproic Acid	Caproic Acid	Heptanoic Acid
August	15	40	4	<2	<2	<2	<5	<2	<2	7
	18	42	29	<2	12	<2	<5	<2	<2	<2
	21	66	39	<2	18	<2	<5	<2	<2	<2
	23	42	30	<2	14	<2	<5	<2	<2	<2
	24	92	64	<2	30	<2	<5	<2	<2	<2
	25	92	70	<2	34	<2	<5	<2	<2	<2
	27	91	58	<2	28	<2	<5	<2	<2	<2
	29	65	45	<2	22	<2	<5	<2	<2	<2
	31	48	38	<2	18	<2	<5	<2	<2	<2

TABLE 10: VOLATILE ACID ANALYSES FROM WELL A3-35

SAMPLE DATE		Acetic Acid	Propionic Acid	Iso-butyric Acid	Butyric Acid	Iso-Valeric Acid	Valeric Acid	Iso-Caproic Acid	Caproic Acid	Heptanoic Acid
August	15	<2	<2	<2	<2	<2	<5	<2	<2	<2
	16	33	24	<2	9	<2	<5	<2	<2	<2
	18	34	24	<2	8	<2	<5	<2	<2	<2
	20	55	38	<2	16	4	13	17	24	59
	23	52	39	<2	13	<2	<5	<2	2	7
	24	63	49	<2	17	<2	<5	<2	2	6
	26	90	58	<2	25	<2	<5	<2	2	3
	28	90	62	<2	27	<2	<5	<2	2	<2
	31	91	61	<2	26	<2	<5	<2	2	<2
September	5	69	46	<2	22	<2	<5	<2	2	<2

TABLE 9: VOLATILE ACID ANALYSES FROM WELL A4-35

SAMPLE DATE		Acetic Acid	Propionic Acid	Iso-butyric Acid	Butyric Acid	Iso-Valeric Acid	Valeric Acid	Iso-Caproic Acid	Caproic Acid	Heptanoic Acid
August	15	5	<2	<2	<2	<2	<5	<2	<2	<2
	16	68	48	<2	17	<2	<5	<2	<2	<2
	18	50	40	<2	13	<2	<5	<2	<2	<2
	20	66	58	<2	20	<2	<5	<2	<2	<2
	23	58	49	<2	16	<2	<5	<2	<2	<2
	24	97	87	<2	33	<2	<5	<2	<2	<2
	26	78	65	<2	24	<2	<5	<2	<2	<2
	28	140	110	<2	40	<2	<5	<2	<2	<2
	31	130	96	<2	36	<2	<5	<2	<2	<2
September	5	110	60	<2	25	<2	<5	<2	3	<2

TABLE 5: VOLATILE ACID ANALYSES FROM WELL A6-35

SAMPLE DATE		Acetic Acid	Propionic Acid	Iso-butyric Acid	Butyric Acid	Iso-Valeric Acid	Valeric Acid	Iso-Caproic Acid	Caproic Acid	Heptanoic Acid
August	15	2100	44	<2	17	<2	<5	<2	<2	<2
	16	69	9	<2	13	<2	<5	<2	<2	<2
	20	42	14	<2	7	<2	<5	<2	<2	<2
	23	10	7	<2	4	<2	<5	<2	<2	<2
	25	42	28	<2	14	<2	<5	<2	<2	<2
	29	99	52	<2	26	<2	<5	<2	<2	<2
September	5	42	27	<2	14	<2	<5	<2	<2	<2

TABLE 2: VOLATILE ACID ANALYSES FROM WELL A12-35

SAMPLE DATE		Acetic Acid	Propionic Acid	Iso-butyric Acid	Butyric Acid	Iso-Valeric Acid	Valeric Acid	Iso-Caproic Acid	Caproic Acid	Heptanoic Acid
August	15	<2	<2	<2	<2	<2	<5	<2	<2	8
	19	70	44	<2	29	2	<5	8	10	39
	20	100	76	<2	38	<2	<5	<2	<2	<2
	21	66	53	<2	24	<2	<5	<2	<2	<2
	23	59	50	<2	23	<2	<5	<2	<2	<2
	24	150	140	<2	87	<2	<5	<2	<2	<2
	25	140	140	<2	81	<2	<5	<2	<2	<2
	26	160	140	<2	78	<2	<5	<2	<2	<2
	27	150	140	<2	80	<2	<5	<2	<2	<2
	28	160	150	<2	82	<2	<5	<2	<2	<2
	29	140	130	<2	73	<2	<5	<2	<2	<2
	31	200	180	<2	100	<2	<5	<2	<2	<2
September	5	77	71	<2	35	<2	<5	<2	2	8
	8	68	54	<2	29	<2	<5	<2	<2	<2

TABLE 7: VOLATILE ACID ANALYSES FROM WELL A9-34

SAMPLE DATE		Acetic Acid	Propionic Acid	Iso-butyric Acid	Butyric Acid	Iso-Valeric Acid	Valeric Acid	Iso-Caproic Acid	Caproic Acid	Heptanoic Acid
August	15	11	<2	<2	<2	<2	<5	<2	<2	<2
	17	41	26	<2	7	<2	<5	3	4	13
	18	47	24	<2	8	<2	<5	<2	4	11
	19	81	47	<2	17	2	6	6	10	29
	21	33	24	<2	8	<2	<5	<2	<2	<2
	24	120	80	<2	30	<2	<5	<2	<2	<2
	26	110	65	<2	28	<2	<5	<2	<2	4
	28	89	46	<2	19	<2	<5	<2	2	4
	31	130	75	<2	34	<2	<5	<2	<2	<2

TABLE 8: VOLATILE ACID ANALYSES FROM WELL A10-34

SAMPLE DATE		Acetic Acid	Propionic Acid	Iso-butyric Acid	Butyric Acid	Iso-Valeric Acid	Valeric Acid	Iso-Caproic Acid	Caproic Acid	Heptanoic Acid
August	15	<2	<2	<2	<2	<2	<5	<2	<2	<2
	16	48	30	<2	11	<2	<5	<2	<2	<2
	17	110	64	<2	21	<2	<5	<2	<2	<2
	19	91	54	<2	19	<2	<5	<2	<2	<2
	21	75	45	<2	16	<2	<5	<2	<2	<2
	24	91	58	<2	21	<2	<5	<2	<2	<2
	26	50	34	<2	13	<2	<5	<2	<2	<2
	28	84	54	<2	20	<2	<5	<2	<2	<2
	31	122	74	<2	30	<2	<5	<2	3	<2

TABLE 6: VOLATILE ACID ANALYSES FROM WELL A16-35

SAMPLE DATE		Acetic Acid	Propionic Acid	Iso-butyric Acid	Butyric Acid	Iso-Valeric Acid	Valeric Acid	Iso-Caproic Acid	Caproic Acid	Heptanoic Acid
August	18	35	23	<2	9	<2	<5	<2	<2	<2
	19	49	30	<2	14	<2	<5	<2	<2	<2
	21	40	28	<2	13	<2	<5	<2	<2	<2
	24	72	44	<2	25	<2	<5	<2	<2	<2
	26	39	22	<2	13	<2	<5	<2	<2	<2
	28	36	21	<2	11	<2	<5	<2	<2	<2

TABLE 4: VOLATILE ACID ANALYSES FROM A5-2 SATELLITE

SAMPLE DATE		Acetic Acid	Propionic Acid	Iso-butyric Acid	Butyric Acid	Iso-Valeric Acid	Valeric Acid	Iso-Caproic Acid	Caproic Acid	Heptanoic Acid
August	10	100	63	<2	34	<2	<5	<2	<2	<2
	14	<2	<2	<2	<2	<2	<5	<2	<2	<2
	16	<2	<2	<2	<2	<2	<5	<2	<2	<2
	20	21	<2	<2	<2	<2	<5	<2	<2	<2
	23	32	15	<2	5	<2	<5	<2	<2	<2
	24	59	34	<2	15	<2	<5	<2	<2	<2
	27	61	34	<2	14	<2	<5	<2	<2	<2
	29	33	16	<2	5	<2	<5	<2	<2	<2

NOVA HUSKY
RESEARCH
CORPORATION

memorandum

DATE: October 14, 1988

TO: Les Stehmeier

FROM: Mark Gerlich

RE: **SUGAR ANALYSES OF STANDARD HILL PRODUCED WATER SAMPLES**

A total of twelve Standard Hill produced water samples have been analyzed for fructose, α-glucose, β-glucose, and sucrose. The technique used for these analyses is found in NHRC Report #183.

As shown in Table 1, only 3 samples contained sugars. These were the only 3 samples in which non-volatile acids were present. A peak with a retention time of 5.2 minutes (between α and β-glucose) appeared in chromatogram of sample A6-35 (August 15, 1988). Based on the response factor of glucose, the sample contains approximately 0.4% (w/v) of this unknown component.

M.G.

/shb
Encl.

cc. Rolf Saetre

TABLE 1: SUGAR ANALYSES OF STANDARD HILL PRODUCED WATERS

SAMPLE IDENTIFICATION	SAMPLE DATE	CONCENTRATION, % (w/v)			
		fructose	α-glucose	β-glucose	sucrose
A 3-2	August 1, 1988	0.5	<.05	<.05	1.0
A 15-2	August 1, 1988	0.2	<.05	<.05	1.3
A 6-35	August 15, 1988	0.2	<.05	<.05	<.05
A 9-34	August 15, 1988	<.05	<.05	<.05	<.05
A10-34	August 15, 1988	<.05	<.05	<.05	<.05
A 3-35	August 15, 1988	<.05	<.05	<.05	<.05
A 4-35	August 15, 1988	<.05	<.05	<.05	<.05
A 5-35	August 15, 1988	<.05	<.05	<.05	<.05
A11-35	August 15, 1988	<.05	<.05	<.05	<.05
A12-35	August 15, 1988	<.05	<.05	<.05	<.05
A 5-02	August 15, 1988	<.05	<.05	<.05	<.05
A 1-3	August 15, 1988	<.05	<.05	<.05	<.05

APPENDIX E

MICROBIAL IDENTIFICATION BY FATTY ACID ANALYSIS, MICROBIAL ID, INC., NEWARK, DELAWARE

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Microbial Identification System (Rev: 3.0) (Sw s/n: 2804A20005)               FLOPPY:F88A23407    03-NOV-88 14:49:11

-  ------------------------------------------------------------------------------------------------------------
ID:      14670      UN-NOVA-HUSKY-6 (32-A3-35-8/25-CONC)                          Date of run: 23-OCT-88 11:51:20
Bottle: 4           STAT SAMPLE [AEROBE]                                          Date edited: 03-NOV-88 09:44:48

   RT      Area    Ar/Ht Respon    ECL           Name             %          Comment 1            Comment 2
 ----  . --------- ------ ------   ------  -------------------- ------  --------------------  --------------------
   .586  35531000  0.071  . . .     7.021  SOLVENT PEAK . . . . . . . .  < min rt
   .863      1712  0.022  . . .     7.606   . . . . . . . . . . . . . .  < min rt
  2.133       578  0.026  . . .     8.188   . . . . . . . . . . . . . .  < min rt
   .184      1409  0.024  . . .     8.297   . . . . . . . . . . . . . .  < min rt
   .900      9464  0.039  0.979    14.000  14:0 . . . . . . . . .  8.07  ECL deviates  0.000  Reference -0.003
  9.722     19388  0.045  0.942    15.819  16:1 CIS 9 . . . . .   15.88  ECL deviates  0.002
   .780     13716  0.043  0.942    15.854  Sum In Feature 4 . .   11.23  ECL deviates -0.002  16:1 TRANS 9/15i2OH
   .017     35807  0.045  0.940    16.000  16:0 . . . . . . . . . 29.26  ECL deviates  0.000  Reference -0.002
 10.811      2242  0.074  0.935    16.466  17:1 ISO H . . . . .    1.82  ECL deviates  0.005
   .149     31111  0.049  0.927    17.821  Sum In Feature 7 . .   25.06  ECL deviates -0.001  18:1 CIS 11/t 9/t 6
   .283      1025  0.051  0.926    18.473  19:1 ISO I . . . . .    0.83  ECL deviates  0.000
   .025      9753  0.050  0.927    18.900  19:0 CYCLO C11-12  .    7.86  ECL deviates  0.000  Reference -0.001
*******     13716  . . . . . . .      . . .  SUMMED FEATURE 4 . .  11.23  15:0 ISO 2OH/16:1t9   16:1 TRANS 9/15i2OH
*  ****     31111  . . . . . . .      . . .  SUMMED FEATURE 7 . .  25.06  18:1 CIS 11/t 9/t 6   18:1 TRANS 9/t6/c11
*  **** . . . . . . . . . . .      . . .  . . . . . . . . . . . . . .  18:1 TRANS 6/t9/c11

Solvent Ar  Total Area  Named Area  % Named  Total Amnt  Nbr Ref  ECL Deviation  Ref ECL Shift
 --------   ----------  ----------  -------  ----------  -------  -------------  -------------
 35531000       122526      122526   100.00      115039        3          0.002          0.002
------------------------------------------------------------------------------------------------------------
         CORYNE [Rev 1.0]   Nova Husky organisms . . . . . . . . . . . . . . . . 0.870
         TSBA [Rev 3.0]     * NO MATCH *
```

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Microbial Identification System (Rev: 3.0) (Sw s/n: 2804A20005)                    FLOPPY:F88A23-07    03-NOV-88 14:49:11

  -----------------------------------------------------------------------------------------------------------------
ID:     14671      UN-NOVA-HUSKY-B (33-A16-34-8/23-CONC)                          Date of run: 23-OCT-88 12:50:55
Bottle: 5          SAMPLE [AEROBE]                                                Date edited: 03-NOV-88 09:45:0-

   RT      Area    Ar/Ht  Respon     ECL          Name               %         Comment 1              Comment 2
 ----  - --------- ------ ------   ------  -------------------- ------  --------------------  --------------------
   .586  35236000  0.070  . . .     7.022  SOLVENT PEAK . . . . . . . .  < min rt
  ..859      1561  0.022  . . .     7.604  . . . . . . . . . . . . . . .  < min rt
  2.131       592  0.024  . . .     8.184  . . . . . . . . . . . . . . .  < min rt
   .183       961  0.024  . . .     8.295  . . . . . . . . . . . . . . .  < min rt
   .899      9165  0.039  0.979    14.000  14:0 . . . . . . . . .   7.46  ECL deviates  0.000   Reference -0.004
  9.720     20860  0.045  0.942    15.818  16:1 CIS 9 . . . . .  16.35  ECL deviates  0.001
  9.776     14833  0.044  0.942    15.853  Sum In Feature 4 . .  11.62  ECL deviates -0.003   16:1 TRANS 9/15i2OH
   .016     35101  0.044  0.940    16.000  16:0 . . . . . . . . .  27.44  ECL deviates -0.000   Reference -0.003
 10.809      1705  0.048  0.935    16.465  17:1 ISO H . . . . .   1.33  ECL deviates  0.004
 13.149     33028  0.049  0.927    17.821  Sum In Feature 7 . .  25.46  ECL deviates -0.001   18:1 CIS 11/t 9/t 6
   .281      1496  0.054  0.926    18.472  19:1 ISO I . . . . .   1.15  ECL deviates -0.001
  ..026     11923  0.053  0.927    18.900  19:0 CYCLO C11-12  .   9.19  ECL deviates  0.000   Reference -0.001
*******     14833  . . . . . . .      . . .  SUMMED FEATURE 4 . .  11.62  15:0 ISO 2OH/16:1t9   16:1 TRANS 9/15i2OH
*******     33028  . . . . . . .      . . .  SUMMED FEATURE 7 . .  25.46  18:1 CIS 11/t 9/t 6   18:1 TRANS 9/t6/c11
- **** . . . . . . . . . . . . .      . . .  . . . . . . . . . . . . . .  18:1 TRANS 6/t9/c11

Solvent Ar  Total Area  Named Area  % Named  Total Amnt  Nbr Ref  ECL Deviation  Ref ECL Shift
  -------   ----------  ----------  -------  ----------  -------  -------------  -------------
 35236000      128111      128111   100.00      120223        3          0.002          0.003
-------------------------------------------------------------------------------------------------------------------
          CORYNE [Rev 1.0]   Nova Husky organisms . . . . . . . . . . . . . . . . 0.936
          TSBA [Rev 3.0]     * NO MATCH *
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Microbial Identification System (Rev: 3.0) (Sw s/n: 2804A20005)                                    FLOPPY:F88A23407    03-NOV-88 14:49:11

- --------------------------------------------------------------------------------------------------------------
ID:      14672     UN-NOVA-HUSKY-B (34-A1-3-8/24-CONC)                                  Date of run: 23-OCT-88 13:20:47
Bottle: 6          SAMPLE [AEROBE]                                                      Date edited: 03-NOV-88 09:45:16

   RT      Area   Ar/Ht Respon    ECL           Name          %          Comment 1              Comment 2
---- . --------- ------ ------  ------ -------------------- ------  --------------------  --------------------
   .586  34820000 0.069  . . .    7.023 SOLVENT PEAK . . . . . . . .  < min rt
   .856      1057 0.021  . . .    7.603  . . . . . . . . . . . . . .  < min rt
  2.182       994 0.023  . . .    8.294  . . . . . . . . . . . . . .  < min rt
   .898      6262 0.038  0.979   14.000 14:0 . . . . . . . . .  5.95  ECL deviates  0.000  Reference -0.005
   .718     16609 0.045  0.942   15.818 16:1 CIS 9 . . . . . . 15.20  ECL deviates  0.001
  9.776     11448 0.043  0.942   15.854 Sum In Feature 4 . .  10.47  ECL deviates -0.002  16:1 TRANS 9/15i2OH
   .013     31022 0.044  0.940   15.999 16:0 . . . . . . . . . 28.32  ECL deviates -0.001  Reference -0.005
   .808      1206 0.048  0.935   16.466 17:1 ISO H . . . . . .  1.09  ECL deviates  0.005
 13.147     31866 0.049  0.927   17.822 Sum In Feature 7 . .  28.68  ECL deviates -0.000  18:1 CIS 11/t 9/t 6
   .281      1365 0.057  0.926   18.474 19:1 ISO I . . . . . .  1.23  ECL deviates  0.001
   .023     10056 0.050  0.927   18.900 19:0 CYCLO C11-12 .    9.05  ECL deviates  0.000  Reference -0.002
   .686      1745 0.113  . . .   20.446  . . . . . . . . . . . . . .  > max rt
-******     11448  . . .  . . .     . . . SUMMED FEATURE 4 . .  10.47  15:0 ISO 2OH/16:1t9  16:1 TRANS 9/15i2OH
*  ****     31866  . . .  . . .     . . . SUMMED FEATURE 7 . .  28.68  18:1 CIS 11/t 9/t 6  18:1 TRANS 9/t6/c11
*  **** . . . . . . . . . . . .     . . .  . . . . . . . . . . . . .  18:1 TRANS 6/t9/c11

Solvent Ar  Total Area  Named Area  % Named  Total Amnt  Nbr Ref  ECL Deviation  Ref ECL Shift
- -------  ----------  ----------  -------  ----------  -------  -------------  -------------
 34820000      109834      109834   100.00      102958        3          0.002          0.004
--------------------------------------------------------------------------------------------------------------
        CORYNE [Rev 1.0]   Nova Husky organisms . . . . . . . . . . . . . . . . . 0.899
        TSBA [Rev 3.0]     * NO MATCH *
```

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Microbial Identification System (Rev: 3.0) (Sw s/n: 2804A20005)                 FLOPPY:FB3A23407    03-NOV-88 14:49:11

 ----------------------------------------------------------------------------------------------------------------------
ID:      14673     UN-NOVA-HUSKY-B (35-A11-35-8/25-CONC)                            Date of run: 23-OCT-88 13:50:35
Bottle: 7          SAMPLE [AEROBE]                                                  Date edited: 03-NOV-88 ?:45:3?

   RT       Area    Ar/Ht  Respon     ECL           Name              %          Comment 1             Comment 2
 ----  - --------- ------ ------   ------  -------------------- ------  --------------------  --------------------
  .586  34892000  0.069   . . .     7.023  SOLVENT PEAK . . . . . . . . < min rt
 ..858      1349  0.022   . . .     7.603   . . . . . . . . . . . . . . < min rt
 2.131       610  0.023   . . .     8.185   . . . . . . . . . . . . . .   min rt
  .182      1070  0.023   . . .     8.294   . . . . . . . . . . . . . . < min rt
  .897      7995  0.039  0.979     14.000  14:0 . . . . . . . . .   6.73  ECL deviates  0.000  Reference -0.005
 9.717     19163  0.045  0.942     15.817  16:1 CIS 9 . . . . . .  15.52  ECL deviates  0.005
  .776     14533  0.045  0.942     15.854  Sum In Feature 4 . .   11.77  ECL deviates -0.002  16:1 TRANS 9/15:20H
  .014     34398  0.044  0.940     16.000  16:0 . . . . . . . . .  27.79  ECL deviates -0.000  Reference -0.004
10.806      1695  0.049  0.935     16.465  17:1 ISO H . . . . . .   1.36  ECL deviates  0.004
13.147     33528  0.049  0.927     17.821  Sum In Feature 7 . .   26.76  ECL deviates -0.001  18:1 CIS 11/t 9/t 6
  .280      1418  0.048  0.926     18.473  19:1 ISO I . . . . . .   1.13  ECL deviates -0.000
 ...023    11292  0.051  0.927     18.900  19:0 CYCLO C11-12  .    8.99  ECL deviates  0.000  Reference -0.002
*******    14533  . . . . . . .     . . .  SUMMED FEATURE 4 . .   11.77  15:0 ISO 2OH/16:1t9   16:1 TRANS 9/15:2OH
*  ****    33528  . . . . . . .     . . .  SUMMED FEATURE 7 . .   26.76  18:1 CIS 11/t 9/t 6   18:1 TRANS 9/t6/c11
*  **** . . . . . . . . . . . .     . . .   . . . . . . . . . . . . . .  18:1 TRANS 6/t9/c11

Solvent Ar  Total Area  Named Area  % Named  Total Amnt  Nbr Ref  ECL Deviation  Ref ECL Shift
 -------   ----------  ----------  -------  ----------  -------  -------------  -------------
 34892000      124022      124022   100.00      116332        3          0.002          0.004
 ----------------------------------------------------------------------------------------------------------------------
         CORYNE [Rev 1.0]   Nova Husky organisms . . . . . . . . . . . . . . . . . 0.936
         TSBA [Rev 3.0]      * NO MATCH *
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Microbial Identification System (Rev: 3.0) (Sw s/n: 2804A20005)                    FLOPPY:F98A23523    03-NOV-88 14:49:11

  -----------------------------------------------------------------------------------------------------------------------
ID:     14674      UN-NOVA-HUSKY-B (37-A10-34-8/17-CONC)                                  Date of run: 23-OCT-88 15:34:23
File: 6            SAMPLE [ABC]                                                           Date edited: 03-NOV-88 09:46:07

   RT      Area    Ar/Ht  Respor     ECL           Name              %          Comment 1             Comment 2
 ----  --------- ------ ------    ------  -------------------- ------  --------------------  --------------------
  .583  34786000 0.069  . . .      7.019  SOLVENT PEAK . . . . . . . .  < min rt
 1.856      1820 0.021  . . .      7.602   . . . . . . . . . . . . . .  < min rt
 2.129       642 0.024  . . .      8.186   . . . . . . . . . . . . . .  < min rt
  .180       746 0.024  . . .      8.295   . . . . . . . . . . . . . .  < min rt
  .894      5793 0.039  0.974     14.001  14:0 . . . . . . . .   6.43  ECL deviates  0.001  Reference -0.002
 9.714     13714 0.044  0.950     15.817  16:1 CIS 9 . . . . .  14.84  ECL deviates  0.000
  .772      9724 0.044  0.949     15.853  Sum In Feature 4 . .  10.52  ECL deviates -0.003  16:1 TRANS 9/15i2OH
  .009     26801 0.044  0.948     15.999  16:0 . . . . . . . .  28.97  ECL deviates -0.001  Reference -0.003
10.803       911 0.045  0.946     16.466  17:1 ISO H . . . . .   0.98  ECL deviates  0.005
13.142     26727 0.049  0.944     17.822  Sum In Feature 7 . .  28.76  ECL deviates  0.000  18:1 CIS 11/t 9/t 6
  .276      1206 0.067  0.946     18.474  19:1 ISO I . . . . .   1.30  ECL deviates  0.001
  .018      7590 0.050  0.948     18.900  19:0 CYCLO C11-12  .   8.20  ECL deviates  0.000  Reference -0.001
-******     9724  . . . . . . .      . . .  SUMMED FEATURE 4 . .  10.52  15:0 ISO 2OH/16:1t9  16:1 TRANS 9/15i2OH
 * ****    26727  . . . . . . .      . . .  SUMMED FEATURE 7 . .  28.76  18:1 CIS 11/t 9/t 6  18:1 TRANS 9/t6/c11
 * **** . . . . . . . . . . . .      . . .   . . . . . . . . . . . . .  18:1 TRANS 6/t9/c11

Solvent Ar  Total Area  Named Area  % Named  Total Amnt  Nbr Ref  ECL Deviation  Ref ECL Shift
 -------   ----------  ----------  -------  ----------  -------  -------------  -------------
 34786000       92466       92466   100.00       87747        3          0.002          0.002
-----------------------------------------------------------------------------------------------------------------------
        CORYNE [Rev 1.0]   Nova Husky organisms . . . . . . . . . . . . . . . 0.790
        TSBA [Rev 3.0]     * NO MATCH *
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Microbial Identification System (Rev: 3.0) (Sw s/n: 2804A20005)                         FLOPPY:F88A23523    03-NOV-88 14:49:11

- -----------------------------------------------------------------------------------------------------------------
ID:      14676      UN-NOVA-HUSKY-B (39-A1-3-8/19-CONC)                                 Date of run: 23-OCT-88 16:34:08
File: 10            SAMPLE [ABC]                                                        Date edited: 03-NOV-88 09:46:18

  RT       Area    Ar/Ht Respon    ECL              Name               %          Comment 1              Comment 2
---- - --------- ------ ------   ------  -------------------- ------  --------------------  --------------------
   .586  36423000 0.073  . . .    7.021  SOLVENT PEAK . . . . . . . .  < min rt
  1.861      1288 0.022  . . .    7.609   . . . . . . . . . . . . . .  < min rt
  2.133       677 0.025  . . .    8.190   . . . . . . . . . . . . . .  < min rt
   .185       927 0.024  . . .    8.301   . . . . . . . . . . . . . .  < min rt
   .900      9509 0.038  0.974   14.001  14:0 . . . . . . . . .   7.33  ECL deviates  0.001  Reference  0.003
  9.721     22194 0.046  0.950   15.817  16:1 CIS 9 . . . . . .  16.69  ECL deviates  0.000
   .779     15649 0.044  0.949   15.853  Sum In Feature 4 . .  11.76  ECL deviates -0.003  16:1 TRANS 9/15:2OH
   .016     36318 0.044  0.948   15.999  16:0 . . . . . . . . .  27.27  ECL deviates -0.001  Reference  0.001
 10.810      1986 0.050  0.946   16.466  17:1 ISO H . . . . . .   1.49  ECL deviates  0.005
 13.149     34734 0.049  0.944   17.822  Sum In Feature 7 . .  25.97  ECL deviates -0.000  18:1 CIS 11/t 9/t 6
   .283      1451 0.054  0.946   18.473  19:1 ISO I . . . . . .   1.09  ECL deviates  0.000
 17.026     11195 0.051  0.948   18.900  19:0 CYCLO C11-12  .   8.40  ECL deviates  0.000  Reference  0.003
*******     15649  . . . . . . .    . . .  SUMMED FEATURE 4 . .  11.76  15:0 ISO 2OH/16:1t9  16:1 TRANS 9/15:2OH
*  ****     34734  . . . . . . .    . . .  SUMMED FEATURE 7 . .  25.97  18:1 CIS 11/t 9/t 6  18:1 TRANS 9/t6/c11
*  **** . . . . . . . . . . .    . . .   . . . . . . . . . . . . .  18:1 TRANS 6/t9/c11

Solvent Ar  Total Area  Named Area  % Named  Total Amnt  Nbr Ref  ECL Deviation  Ref ECL Shift
- -------  ----------  ----------  -------  ----------  -------  -------------  -------------
 36423000      133036      133036   100.00      126295        3          0.002          0.003
-----------------------------------------------------------------------------------------------------------------
         CORYNE [Rev 1.0]   Nova Husky organisms . . . . . . . . . . . . . . . . 0.945
         TSBA [Rev 3.0]     * NO MATCH *
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Microbial Identification System (Rev: 3.0) (Sw s/n: 2804A20005)                 FLOPPY:F86A23523    03-NOV-88 14:49:11

- -----------------------------------------------------------------------------------------------------
ID:     14677     UN-NOVA-HUSKY-B (40-A15-2-8/1-CONC)                      Date of run: 23-OCT-88 17:04:01
Bottle: 11        SAMPLE [AEC]                                             Date edited: 03-NOV-88 09:46:30

  RT       Area   Ar/Ht Respon    ECL          Name             %        Comment 1           Comment 2
---- . --------- ------ ------  ------ -------------------- ------  -------------------- --------------------
  .586  39316000 0.078  . . .    7.015 SOLVENT PEAK . . . . . . . .  < min rt
 1.866      1136 0.021  . . .    7.613 . . . . . . . . . . . . . . .  < min rt
 2.139       833 0.026  . . .    8.196 . . . . . . . . . . . . . . .  < min rt
  .191       825 0.028  . . .    8.308 . . . . . . . . . . . . . . .  < min rt
  .664       667 0.041  . . .   13.815 . . . . . . . . . . . . . . .
 6.909     10901 0.039  0.974   14.001 14:0 . . . . . . . . .   6.72 ECL deviates  0.001  Reference  0.009
 9.730     26218 0.046  0.950   15.817 16:1 CIS 9 . . . . .  15.76 ECL deviates -0.000
  .789     18452 0.043  0.949   15.853 Sum In Feature 4 . .  11.09 ECL deviates -0.003  16:1 TRANS 9/15:20H
10.027     43411 0.044  0.948   15.999 16:0 . . . . . . . . .  26.06 ECL deviates -0.001  Reference  0.008
10.819      2426 0.049  0.946   16.465 17:1 ISO H . . . . .   1.45 ECL deviates  0.004
  .161     51134 0.050  0.944   17.822 Sum In Feature 7 . .  30.56 ECL deviates  0.000  18:1 CIS 11/t 9/t 6
11.295      2420 0.056  0.946   18.474 19:1 ISO I . . . . .   1.45 ECL deviates  0.001
15.037     11515 0.050  0.948   18.900 19:0 CYCLO C11-12  .   6.91 ECL deviates  0.000  Reference  0.010
 * ****    18452 . . . . . . .    . . . SUMMED FEATURE 4 . .  11.09 15:0 ISO 20H 16:1t9  16:1 TRANS 9/15i20H
 * ****    51134 . . . . . . .    . . . SUMMED FEATURE 7 . .  30.56 18:1 CIS 11/t 9/t 6  18:1 TRANS 9/t6/c11
******* . . . . . . . . . . . .   . . . . . . . . . . . . . . . .  18:1 TRANS 6/t9/c11

Solvent Ar  Total Area  Named Area  % Named  Total Amnt  Nbr Ref  ECL Deviation  Ref ECL Shift
----------  ----------  ----------  -------  ----------  -------  -------------  -------------
 39316000      167144      166477    99.60      157982        3          0.002          0.009
- -----------------------------------------------------------------------------------------------------
        CORYNE [Rev 1.0]   Nova Husky organisms . . . . . . . . . . . . . . . . 0.952
        TSBA [Rev 3.0]     Vibrio . . . . . . . . . . . . . . . . . . . . . . . 0.001
                             V. fluvialis . . . . . . . . . . . . . . . . . . . 0.001
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Microbial Identification System (Rev: 3.3) (Sw s/n: 2904A20005)                    FLOPPY:F88A23523    03-NOV-88 14:49:11

- ------------------------------------------------------------------------------------------------------------------------
ID:      14678      UN-NOVA-HUSKY-B (41-A4-35-8/24-CONC)                                Date of run: 23-OCT-88 17:33:55
Bottle: 12          SAMPLE [ABC]                                                        Date edited: 03-NOV-88 09:46:46

   RT      Area    Ar/Ht Respon     ECL            Name              %          Comment 1              Comment 2
---- - --------- ------ ------   ------  -------------------- ------  --------------------  --------------------
   .589  42135000 0.084  . . .     7.020  SOLVENT PEAK . . . . . . . . < min rt
  ..870      1864 0.026  . . .     7.620  . . . . . . . . . . . . . . < min rt
  2.144       872 0.027  . . .     8.206  . . . . . . . . . . . . . . < min rt
   .195       893 0.027  . . .     8.315  . . . . . . . . . . . . . . < min rt
   .509       837 0.036  1.031    12.006  12:0 . . . . . . . .   0.87  ECL deviates  0.006
  6.671       903 0.043  . . .    13.818  . . . . . . . . . . . . . .
   .913     24407 0.039  0.974    14.001  14:0 . . . . . . . .  23.93  ECL deviates  0.001   Reference  0.011
   .734     11029 0.046  0.950    15.818  16:1 CIS 9 . . . . .  10.54  ECL deviates  0.001
   .792      5678 0.042  0.949    15.853  Sum In Feature 4 . .   5.43  ECL deviates -0.003   16:1 TRANS 9/15i2OH
 10.030     39831 0.044  0.948    15.999  16:0 . . . . . . . .  38.03  ECL deviates -0.001   Reference  0.009
   .070      1197 0.051  0.944    17.769  18:1 CIS 9 . . . . .   1.14  ECL deviates  0.000
  ..163     15461 0.049  0.944    17.823  Sum In Feature 7 . .  14.70  ECL deviates  0.001   18:1 CIS 11/t 9/t 6
 13.469       714 0.041  0.945    17.998  18:0 . . . . . . . .   0.68  ECL deviates -0.002   Reference  0.006
   .039      4921 0.057  0.948    19.902  19:0 CYCLO C11-12  .   4.69  ECL deviates  0.002   Reference  0.011
* ****       5678  . . .  . . .     . . .  SUMMED FEATURE 4 . .   5.43  15:0 ISO 2OH/16:1t9   16:1 TRANS 9/15i2OH
*******     15461  . . .  . . .     . . .  SUMMED FEATURE 7 . .  14.70  18:1 CIS 11/t 9/t 6   18:1 TRANS 9/t6/c1.
-****** . . . . . . . . . . . . .  . . .   . . . . . . . . . . . . . . 18:1 TRANS 6/t9/c11

Solvent Ar  Total Area  Named Area  % Named  Total Amnt  Nbr Ref  ECL Deviation  Ref ECL Shift
----------  ----------  ----------  -------  ----------  -------  -------------  -------------
 .2135000      104978      104075    99.14       99339        4          0.002          0.010
 ------------------------------------------------------------------------------------------------------------------------
        CORYNE [Rev 1.0]    * NO MATCH *
        TSBA [Rev 3.0]      Campylobacter . . . . . . . . . . . . . . . . . . . . 0.023 (72hr.Mueller Hinton+Blood.3.5% O2)
                                C. jejuni . . . . . . . . . . . . . . . . . . . . 0.023 (72hr.Mueller Hinton+Blood.3.5% O2)
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Microbial Identification System (Rev: 3.0) (Sw s/n: 2804A20005)                    FLOPPY:F88A24399    03-NOV-88 14:49:11

- ---------------------------------------------------------------------------------------------------------------------
ID:     14689    UN-NOVA-HUSKY-B (43-A3-2-8/1-CONC)                                Date of run: 24-OCT-88 16:08:07
File: 22         SAMPLE [ABC]                                                      Date edited: 03-NOV-86 09:49:02

  RT      Area    Ar/Ht  Respon     ECL           Name              %          Comment 1              Comment 2
- - - --------- ------ ------    ------  -------------------- ------  --------------------  --------------------
   .583 34373000 0.068  . . .     7.023  SOLVENT PEAK . . . . . . . . .  < min rt
  1.854     1905 0.026  . . .     7.602   . . . . . . . . . . . . . .  < min rt
  2.126      682 0.023  . . .     8.183   . . . . . . . . . . . . . .  < min rt
   .178     1096 0.023  . . .     8.294   . . . . . . . . . . . . . .  < min rt
  ..873      768 0.034  . . .     9.779   . . . . . . . . . . . . . .
  6.648      993 0.043  . . .    13.816   . . . . . . . . . . . . . .
   .708     1102 0.039  . . .    13.862   . . . . . . . . . . . . . .
   .890    16156 0.039  0.988    14.000  14:0 . . . . . . . . .  13.04  ECL deviates  0.000  Reference -0.005
  9.710    23201 0.046  0.946    15.818  16:1 CIS 9 . . . . . .  17.94  ECL deviates  0.001
  9.769    14904 0.042  0.945    15.854  Sum In Feature 4 . .  11.51  ECL deviates -0.002  16:1 TRANS 9/15:2OH
   .006    36518 0.044  0.943    16.000  16:0 . . . . . . . . .  28.14  ECL deviates -0.000  Reference -0.004
 10.799     1365 0.046  0.936    16.466  17:1 ISO H . . . . . .   1.04  ECL deviates  0.005
 13.138    28998 0.049  0.921    17.821  Sum In Feature 7 . .  21.74  ECL deviates -0.001  18:1 CIS 11/t 9/t 6
   .016     8816 0.050  0.914    18.900  19:0 CYCLO C11-12  .   6.59  ECL deviates  0.000  Reference -0.002
   .049     8512 0.220  . . .    20.379   . . . . . . . . . . . . . .  > max rt
*******    14904  . . . . . . .   . . .  SUMMED FEATURE 4 . .  11.51  15:0 ISO 2OH/16:1t9   16:1 TRANS 9/15:2OH
*******    28898  . . . . . . .   . . .  SUMMED FEATURE 7 . .  21.74  18:1 CIS 11/t 9/t 6   18:1 TRANS 9/t6/c11
*  **** . . . . . . . . . . .     . . .   . . . . . . . . . . . . . .  18:1 TRANS 6/t9/c11

Solvent Ar  Total Area  Named Area  % Named  Total Amnt  Nbr Ref  ECL Deviation  Ref ECL Shift
- -------  ----------  ----------  -------  ----------  -------  -------------  -------------
 34373000      132721      129858    97.84      122380        3          0.002          0.004
-------------------------------------------------------------------------------------------------------------------
        CORYNE [Rev 1.0]   Nova Husky organisms . . . . . . . . . . . . . . . . 0.460
        TSBA [Rev 3.0]     Vibrio . . . . . . . . . . . . . . . . . . . . . . . 0.002
                              V. fluvialis . . . . . . . . . . . . . . . . . . . 0.002
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Microbial Identification System (Rev: 3.0) (Sw s/n: 2804A20005)                   FLOPPY:F88A24399    03-NOV-88 14:49:11

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ID:      14690       UN-NOVA-HUSKY-B (44-A6-35-8/19-CONC)                           Date of run: 24-OCT-86 16:37:53
Bottle: 23           SAMPLE [ABC]                                                   Date edited: 03-NOV-88 09:49:17

    RT     Area   Ar/Ht Respon    ECL            Name             %          Comment 1              Comment 2
  ---- - --------- ------ ------  ------ -------------------- ------  --------------------  --------------------
  ..586 34645000 0.069  . . .    7.030  SOLVENT PEAK . . . . . . . .  < min rt
  ..856     2671 0.025  . . .    7.607   . . . . . . . . . . . . . .  < min rt
  2.128      830 0.024  . . .    8.188   . . . . . . . . . . . . . .  < min rt
  2.179     1693 0.024  . . .    8.297   . . . . . . . . . . . . . .  < min rt
   .874      823 0.042  . . .    9.782   . . . . . . . . . . . . . .
  6.890    14964 0.039  0.988   14.000  14:0 . . . . . . . . .  17.33  ECL deviates  0.000   Reference -0.005
  9.709    10361 0.045  0.946   15.818  16:1 CIS 9 . . . . .  11.49  ECL deviates  0.001
   .769     6364 0.043  0.945   15.855  Sum In Feature 4 . .   7.05  ECL deviates -0.001   16:1 TRANS 9/15i2OH
 10.006    39746 0.043  0.943   16.000  16:0 . . . . . . . . .  43.93  ECL deviates  0.000   Reference -0.004
 13.139    11823 0.049  0.921   17.823  Sum In Feature 7 . .  12.76  ECL deviates  0.001   18:1 CIS 11/t 9/t 6
   .445     1015 0.054  0.919   17.998  18:0 . . . . . . . . .   1.09  ECL deviates -0.002   Reference -0.006
   .014     5913 0.051  0.914   18.901  19:0 CYCLO C11-12  .   6.34  ECL deviates  0.001   Reference -0.004
*******     6364 . . . . . . .    . . .  SUMMED FEATURE 4 . .   7.05  15:0 ISO 2OH/16:1t9   16:1 TRANS 9/15i2OH
*******    11823 . . . . . . .    . . .  SUMMED FEATURE 7 . .  12.76  18:1 CIS 11/t 9/t 6   18:1 TRANS 9/t6/c11
*  **** . . . . . . . . . . .    . . .   . . . . . . . . . . . . . .  18:1 TRANS 6/t9/c11

Solvent Ar  Total Area  Named Area  % Named  Total Amnt  Nbr Ref  ECL Deviation  Ref ECL Shift
 --------   ----------  ----------  -------  ----------  -------  -------------  -------------
 .4645000       91009       90186    99.10       85305        4          0.001          0.005
--------------------------------------------------------------------------------------------------------------------------
        CORYNE [Rev 1.0]    * NO MATCH *
        TSBA [Rev 3.0]      Campylobacter  . . . . . . . . . . . . . . . . . . . . 0.002 (72hr.Mueller Hinton+Blood.3.5% O2)
                              C. jejuni  . . . . . . . . . . . . . . . . . . . . . 0.002 (72hr.Mueller Hinton+Blood.3.5% O2)
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Microbial Identification System (Rev: 3.0 (Sw s/n: 2804A20005)                                  FLOPPY:F88A24399   03-NOV-88 14:49:11

- ----------------------------------------------------------------------------------------------------------
ID:     14691      UN-NOVA-HUSKY-B (45-Ag-34-8/24-CONC)                          Date of run: 24-OCT-88 12:09:28
Bottle: 24         STAT SAMPLE [ABC]                                             Date edited: 03-NOV-88 09:48:10

   RT      Area   Ar/Ht Respon     ECL           Name             %        Comment 1            Comment 2
 ----  --------- ------ ------   ------ -------------------- ------ -------------------- --------------------
  .586  34592000  0.069  . . .    7.027 SOLVENT PEAK . . . . . . . . < min rt
 1.856      1690  0.022  . . .    7.604  . . . . . . . . . . . . . . < min rt
 2.128       809  0.024  . . .    8.185  . . . . . . . . . . . . . . < min rt
  .180       943  0.024  . . .    8.296  . . . . . . . . . . . . . . < min rt
  .651      1009  0.044  . . .   13.815  . . . . . . . . . . . . . .
 6.893     15113  0.039  0.988   14.000 14:0 . . . . . . . . .   8.29 ECL deviates -0.000 Reference -0.002
 7.714     30855  0.045  0.946   15.818 16:1 CIS 9 . . . . .  16.20 ECL deviates  0.001
  .773     22462  0.043  0.945   15.854 Sum In Feature 4 . .  11.79 ECL deviates -0.002 16:1 TRANS 9/15i2OH
10.011     57127  0.045  0.943   16.000 16:0 . . . . . . . . .  29.90 ECL deviates  0.000 Reference -0.001
10.804      2117  0.048  0.936   16.466 17:1 ISO H . . . . .   1.10 ECL deviates  0.005
  .143     47923  0.048  0.921   17.821 Sum In Feature 7 . .  24.49 ECL deviates -0.001 18:1 CIS 11/t 9/t 6
  .584      1384  0.076  . . .   18.074  . . . . . . . . . . . . . .
14.278      1396  0.048  0.916   18.474 19:1 ISO I . . . . .   0.71 ECL deviates  0.001
  .019     13835  0.051  0.914   18.900 19:0 CYCLO C11-12  .   7.02 ECL deviates -0.000 Reference -0.001
  .457      1013  0.062  0.912   19.734 unknown 19.735 . . .   0.51 ECL deviates -0.001
*******    22462  . . . . . . .     . . . SUMMED FEATURE 4 . .  11.79 15:0 ISO 2OH/16:1t9  16:1 TRANS 9/15i2OH
*******    47923  . . . . . . .     . . . SUMMED FEATURE 7 . .  24.49 18:1 CIS 11/t 9/t 6  18:1 TRANS 9/t6/c11
• **** . . . . . . . . . . . .     . . .  . . . . . . . . . . . . . . 18:1 TRANS 6/t9/c11

Solvent Ar  Total Area  Named Area  % Named  Total Amnt  Nbr Ref  ECL Deviation  Ref ECL Shift
- -------   ----------  ----------  -------  ----------  -------  -------------  -------------
 .4592000      194234      191841    98.77      180181        3          0.002          0.002
----------------------------------------------------------------------------------------------------------
           CORYNE [Rev 1.0]   Nova Husky organisms . . . . . . . . . . . . . . . . 0.786
           TSBA [Rev 3.0]     Vibrio . . . . . . . . . . . . . . . . . . . . . . . 0.001
                                V. fluvialis . . . . . . . . . . . . . . . . . . . 0.001
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Microbial Identification System (Rev: 3.0) (Sw s/n: 2804A20005)                    FLOPPY:F88A24399    03-NOV-88 14:49:11

- -------------------------------------------------------------------------------------------------------------------------
ID:     14685      UN-NOVA-HUSKY-6 (48-A5-35-8/19-CONC)                                  Date of run: 24-OCT-88 14:38:26
File: 19           SAMPLE [ABC]                                                          Date edited: 03-NOV-88 09:46:28

   RT       Area   Ar/Ht Respon    ECL          Name               %          Comment 1              Comment 2
- - . --------- ------ ------   ------ -------------------- ------  --------------------  --------------------
  .583  34573000  0.069  . . .    7.024  SOLVENT PEAK . . . . . . . . .  < min rt
 1.855      1875  0.022  . . .    7.605  . . . . . . . . . . . . . . . .  < min rt
 2.126       696  0.023  . . .    8.184  . . . . . . . . . . . . . . . .  < min rt
  .179       857  0.022  . . .    8.297  . . . . . . . . . . . . . . . .  < min rt
  .889      8938  0.039  0.988   14.000  14:0 . . . . . . . . .   7.68  ECL deviates  0.000   Reference -0.005
 9.709     20796  0.045  0.946   15.818  16:1 CIS 9 . . . . . .  17.12  ECL deviates  0.001
  .766     14515  0.044  0.945   15.853  Sum In Feature 4 . .  11.94  ECL deviates -0.003   16:1 TRANS 9/15:2OH
  .005     33714  0.044  0.943   16.000  16:0 . . . . . . . . .  27.66  ECL deviates -0.000   Reference -0.005
10.798      1801  0.047  0.936   16.466  17:1 ISO H . . . . . .   1.47  ECL deviates  0.005
13.137     30006  0.048  0.921   17.821  Sum In Feature 7 . .  24.04  ECL deviates -0.001   18:1 CIS 11/t 9/t 6
  .272      1300  0.049  0.916   18.473  19:1 ISO I . . . . . .   1.04  ECL deviates  0.000
15.014     11392  0.050  0.914   18.900  19:0 CYCLO C11-12  .   9.06  ECL deviates  0.000   Reference -0.004
17.677      2331  0.171  . . .   20.447  . . . . . . . . . . . . . . . .  > max rt
* ****     14515  . . . . . . .    . . .  SUMMED FEATURE 4 . .  11.94  15:0 ISO 2OH/16:1t9   16:1 TRANS 9/15:2OH
* ****     30006  . . . . . . .    . . .  SUMMED FEATURE 7 . .  24.04  18:1 CIS 11/t 9/t 6   18:1 TRANS 9/t6/c11
******* . . . . . . . . . . . .    . . .  . . . . . . . . . . . . . . . .  18:1 TRANS 6/t9/c11

Solvent Ar  Total Area  Named Area  % Named  Total Amnt  Nbr Ref  ECL Deviation  Ref ECL Shift
----------  ----------  ----------  -------  ----------  -------  -------------  -------------
  34573000      122462      122462   100.00      114937        3          0.002          0.005
 -------------------------------------------------------------------------------------------------------------------------
        CORYNE [Rev 1.0]   Nova Husky organisms . . . . . . . . . . . . . . . . 0.897
        TSBA [Rev 3.0]     * NO MATCH *
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Microbial Identification System (Rev: 3.0) (Sw s/n: 2804A20005)                       FLOPPY:F88A24399    03-NOV-88 14:49:11

 - ----------------------------------------------------------------------------------------------------------
ID:      14686     UN-NOVA-HUSKY-E (49-A-16-34-8/21-MIN-CON                      Date of run: 24-OCT-88 15:08:25
Bottle: 20         SAMPLE [ABC]                                                  Date edited: 03-NOV-88 09:48:38

   RT      Area    Ar/Ht Respon     ECL           Name             %         Comment 1              Comment 2
  ----  --------- ------ ------   ------  -------------------- ------  --------------------  --------------------
   .583  34450000  0.069  . . .    7.024  SOLVENT PEAK . . . . . . . .  < min rt
   .855       718  0.024  . . .    7.605  . . . . . . . . . . . . . . . < min rt
  2.126       497  0.024  . . .    8.184  . . . . . . . . . . . . . . . < min rt
   .179       520  0.023  . . .    8.297  . . . . . . . . . . . . . . . < min rt
   .889      7287  0.038  0.988   14.000  14:0 . . . . . . . . .   6.34  ECL deviates -0.000   Reference -0.005
  9.709     25993  0.047  0.946   15.817  16:1 CIS 9 . . . . .   21.65  ECL deviates  0.000
  9.768      5310  0.038  0.945   15.854  Sum In Feature 4 . .   4.42  ECL deviates -0.002   16:1 TRANS 9/15i2OH
   .006     29948  0.044  0.943   16.000  16:0 . . . . . . . .  24.86  ECL deviates  0.000   Reference -0.004
 10.797       646  0.038  0.936   16.465  17:1 ISO H . . . . .   0.53  ECL deviates  0.004
 13.139     41337  0.049  0.921   17.822  Sum In Feature 7 . .  33.50  ECL deviates -0.000   18:1 CIS 11/t 9/t 6
   .014     10818  0.053  0.914   18.900  19:0 CYCLO C11-12  .   8.71  ECL deviates  0.000   Reference -0.004
 *****       5310  . . . . . . .   . . .  SUMMED FEATURE 4 . .   4.42  15:0 ISO 2OH/16:1t9   16:1 TRANS 9/15i2OH
*******     41337  . . . . . . .   . . .  SUMMED FEATURE 7 . .  33.50  18:1 CIS 11/t 9/t 6   18:1 TRANS 9/t6/c11
******* . . . . . . . . . . . . .  . . .  . . . . . . . . . . . . . .  18:1 TRANS 6/t9/c11

Solvent Ar  Total Area  Named Area  % Named  Total Amnt  Nbr Ref  ECL Deviation  Ref ECL Shift
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  4450000      121339      121339   100.00      113605        3          0.002          0.004
 - ----------------------------------------------------------------------------------------------------------
        CORYNE [Rev 1.0]   Nova Husky organisms . . . . . . . . . . . . . . . . 0.280
        TSBA [Rev 3.0]     Enterococcus . . . . . . . . . . . . . . . . . . . . 0.085 (48 hrs. Streptococcus faecalis)
                             E. faecalis  . . . . . . . . . . . . . . . . . . . 0.085 (48 hrs. Streptococcus faecalis)
                             E. faecium . . . . . . . . . . . . . . . . . . . . 0.064 (48 hrs. Streptococcus faecium)
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